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How to improve urban mobility in Lisbon: intermodality and information and ticketing systems

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Abstract

Urban mobility is one of the main challenges facing urban areas due to the growing population and to traffic congestion, resulting in environmental pressures.

The pathway to urban sustainable mobility involves strengthening of intermodal mobility. The integrated use of different transport modes is getting more and more important and intermodality has been mentioned as a way for public transport compete with private cars.

The aim of the current dissertation is to define a set of strategies to improve urban mobility in Lisbon and by consequence reduce the environmental impacts of transports. In order to do that several intermodal practices over Europe were analysed and the transport systems of Brussels and Lisbon were studied and compared, giving special attention to intermodal systems. In the case study was gathered data from both cities in the field, by using and observing the different transport modes, and two surveys were done to the cities users.

As concluded by the study, Brussels and Lisbon present significant differences. In Brussels the measures to promote intermodality are evident, while in Lisbon a lot still needs to be done. It also made clear the necessity for improvements in Lisbon's public transports to a more intermodal passenger transport system, through integration of different transport modes and better information and ticketing system. Some of the points requiring developments are: interchanges' waiting areas; integration of bicycle in public transport; information about correspondences with other transport modes; real-time information to passengers pre-trip and on-trip, especially in buses and trams.

After the identification of the best practices in Brussels and the weaknesses in Lisbon the possibility of applying some of the practices in Brussels to Lisbon was evaluated. Brussels demonstrated to be a good example of intermodality and for that reason some of the recommendations to improve intermodal mobility in Lisbon can follow the practices in place in Brussels.

Keywords: *intermodality, information systems, sustainable mobility, ticketing system, urban mobility*

Resumo

A mobilidade é um dos principais desafios que as áreas urbanas enfrentam devido ao crescimento da população e ao congestionamento do tráfego, resultando em pressões ambientais.

O caminho para uma mobilidade urbana sustentável envolve o reforço da mobilidade intermodal. O uso integrado de diferentes modos de transporte está a tornar-se cada vez mais importante e a intermodalidade foi mencionada como uma forma do transporte público competir com o automóvel individual.

O objetivo da dissertação é definir um conjunto de estratégias para melhorar a mobilidade urbana em Lisboa e, por consequência, reduzir os impactos ambientais dos transportes. De modo a atingir esse objetivo, foram analisadas várias práticas intermodais na Europa e foram estudados e comparados os sistemas de transporte de Bruxelas e Lisboa, dando especial atenção aos sistemas intermodais. No caso de estudo reuniram-se dados de ambas as cidades, através do uso e observação dos diferentes modos de transporte e da realização de dois inquéritos aos utilizadores da cidade.

No estudo, Bruxelas e Lisboa apresentaram diferenças significativas. Em Bruxelas, as medidas destinadas a promover a intermodalidade são evidentes, enquanto em Lisboa muito ainda precisa ser feito. O presente estudo evidenciou a necessidade de melhorias nos transportes públicos de Lisboa para um melhor sistema de transporte intermodal de passageiros, através da integração de diferentes modos de transporte e uma melhor informação e sistema de bilhética. Alguns dos pontos que requerem desenvolvimentos são: áreas de espera nos interfaces; integração de bicicletas nos transportes públicos; informações sobre correspondências com outros modos de transporte; informações em tempo real aos passageiros antes da viagem e durante a viagem, especialmente em autocarros e eléctricos.

Após a identificação das melhores práticas em Bruxelas e das fraquezas em Lisboa avaliou-se a possibilidade de se aplicar em Lisboa algumas das práticas em Bruxelas. Tendo esta demonstrado ser um bom exemplo de intermodalidade, algumas das recomendações para melhorar a intermodalidade em Lisboa podem seguir as práticas em vigor em Bruxelas.

Palavras-chave: *intermodalidade, mobilidade sustentável, mobilidade urbana, sistemas de bilhética, sistemas de informação*

Resumé

La mobilité urbaine est l'un des principaux défis dans les zones urbaines en raison de la croissance de la population et de la congestion de la circulation, ce qui entraîne des pressions environnementales. La voie à une mobilité durable implique le renforcement de la mobilité intermodale. Cette a été mentionné une façon des transports publics rivaliser avec les voitures privées.

L'objectif de cette mémoire est de définir un ensemble de stratégies visant à améliorer la mobilité urbaine à Lisbonne et par conséquent de réduire les impacts environnementaux des transports. Afin de faire cela, plusieurs pratiques en Europe ont été analysés et les systèmes de transport de Bruxelles et de Lisbonne ont été étudiées et comparées. Dans le cas d'étude a été recueilli des données des deux villes, en utilisant et en observant les différents modes de transport, et deux enquêtes ont été fait pour les utilisateurs des villes.

Bruxelles et Lisbonne ont présenté des différences significatives. À Bruxelles, les mesures visant à promouvoir l'intermodalité sont évidents, pendant qu'à Lisbonne il reste encore beaucoup à faire. Cette étude montre clairement la nécessité de l'amélioration des transports publics de Lisbonne à un meilleur système de transport intermodal de passagers, grâce à l'intégration des différents modes de transport et un meilleur système d'information et de billetterie. Certains des points nécessitant des développements sont: les zones d'attente des échangeurs; l'intégration du vélo dans les transports publics; informations sur les correspondances avec d'autres modes de transport; informations en temps réel aux passagers avant le départ et pendant le voyage, en particulier dans les bus et les trams.

Après l'identification des meilleures pratiques à Bruxelles et les faiblesses de Lisbonne a était d'évaluer la possibilité d'appliquer à Lisbonne certaines des pratiques de Bruxelles. Bruxelles a démontré être un bon exemple de l'intermodalité et pour cette raison, certaines des recommandations pour améliorer l'intermodalité à Lisbonne peuvent suivre les pratiques en place à Bruxelles.

Mots-clés: *intermodalité, mobilité durable, mobilité urbaine, système de billetterie, systèmes d'information*

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List of Acronyms

AML - *Área Metropolitana de Lisboa* (Lisbon Metropolitan Area)

BISA - Brussels Institute for Statistics and Analysis

CIRB – *Centre d'Informatique pour la Région Bruxelloise* (Brussels Regional Informatics Centre)

CML – *Câmara Municipal de Lisboa* (Lisbon City Council)

CO - Carbon Monoxide

CO_2 - Carbon Dioxide

CP – *Comboios de Portugal* (Trains of Portugal)

EC – European Commission

EP - European Parliament

EPOMM - European Platform on Mobility Management

EU - European Union

EEA – European Environmental Agency

FCT/UNL – *Faculdade de Ciências e Tecnologia / Universidade Nova de Lisboa*

GDP – Gross Domestic Product

GHG – Greenhouse Gas

IMTT - *Instituto da Mobilidade e dos Transportes Terrestres* (current IMT – *Institudo da Mobilidade e dos Transportes*)

ML – *Metropolitano de Lisboa* (Lisbon Metropolitan)

NH_3 - Ammonia

NMVOCs - Non-Methane Volatile Organic Compounds

NO_X – Nitrogen Oxides

PM - Particulates (PM_{10} or $PM_{2,5}$)

RBC – *Région de Bruxelles-Capitale* (Brussels Capital Region)

STIB - *Société des transports intercommunaux de Bruxelles* (Brussels Intercommunal Transport Company, in Dutch: *Maatschappij voor het Intercommunaal Vervoer te Brussel* or MIVB)

SNCB - *Société nationale des chemins de fer belges* (National Railway Company of Belgium, in Dutch: *Nationale Maatschappij der Belgische Spoorwegen* or NMBS)

SO_x – Sulphur Oxides

TfL - Transport for London

UITP - International Association of Public Transport

ULB – *Université Libre de Bruxelles*

WBCSD - World Business Council for Sustainable Development

1 INTRODUCTION

1.1 Framework

Mobility is one of the main challenges in urban areas as a consequence of the growing population and traffic congestion. Although it is not a completely new issue, it is expected to become worse if nothing is done as is expected that more people will move to the outskirts of the cities in the next few years.

If it is true that transportation guarantees mobility, it also true that it puts a lot of pressure on the environment. It contributes to an unsustainable use of natural resources, to greenhouse gas (GHG), and to air pollution and noise emissions (EEA, 2013). According to the European Environmental Agency (EEA), urban transport accounts for 40% of all CO_2 emissions and 70% of other pollutants from European road transport (EEA, 2013). A target to reduce the GHG emissions from transports was proposed in the European Commission (EC) 2011 Transport White Paper. It required each European Union (EU) Member State to reduce transport's GHGs by 60% by 2050 compared to 1990 levels (EC, 2011). However, since emissions actually increased by 27% between 1990 and 2009, the EU must make an overall 68% reduction by 2050 in order to meet the target (EEA, 2014a).

In spite of all the efforts to promote public transport as a way to achieve the above target, the car still remains the dominant mode of transport for the majority, with a share above 70% in passenger transport. It should be noted that, between 2010 and 2011 the number of new car registrations increased significantly in many EU countries (EEA, 2014b). The lack of a good public transport network, especially for commuting (house-work and house-school movements), has made people more and more car-dependant (EU, 2011). The private car should not be the first choice when travelling in urban areas. However, for it to change, other solutions such as public transport or soft mobility must be of good quality and efficient. An efficient public transport system coordinated with soft mobility solutions, such as the bicycle and walking, or with sharing systems such as bike-sharing and car-sharing could be one way to reduce the travel time in cities and improve service quality.

Cities are becoming saturated of cars, and therefore its number in cities must be reduced, not just as an environmental measure but as something fundamental for the "cities users". Since in fact, traffic congestion costs the EU more than one percent of gross domestic product (GDP) (EEA, 2014c; IBM, 2010). There is though a growing need for more attractive alternative means of transportation to the car. As noted by EU, non-car mobility has to become more attractive and multimodal public transport systems favoured (EU, 2011). The synergies of the different modes of transport must be brought together in order to improve mobility.

Significant progresses have been made in reducing the emissions of many air pollutants from the transport sector. Likewise much has been done in terms of infrastructures, equipment and alternative and clean fuels to replace petrol. Nevertheless, besides all the innovations to make transport greener (e.g. more ecological vehicles of transport), it is important to use them in an

efficient way, taking the most possible benefits from that. Because even if operators have a cleaner fleet, if the service provided is not good, it won't be attractive for people. Consequently, all the environmental benefits of an eco-fleet will be useless. In contrast, a good passenger transport service (e.g. public transport or soft mobility alternatives) could make people leave their car at home, at least while commuting. This is what this project is about.

Hence, urban mobility is an important issue that must be addressed since it contributes to cities sustainability. It can reduce traffic jams, GHGs emissions, improving air quality and improving people's life quality by facilitating travel and making them save time usually wasted in travel, time that could be used in another activity more enjoyable and/or more profitable.

1.2 Objectives and Research Scope

The main goal of this work is to assess how to contribute to urban sustainability by improving mobility. More precisely, this dissertation aims to promote intermodal passenger transport systems by focusing on the improvement of transport infrastructures and its information and ticketing systems. The underlying motivation is to enhance public transport and soft mobility competitiveness, especially for commuting.

This dissertation proposes some new mobility strategies to the city of Lisbon in terms of passenger intermodality. These aim to decrease the amount of cars in the city centre and consequently to improve environmental conditions for visitors and residents.

This research work takes into consideration the following assumptions:

- A person will choose the public transport or soft mobility option over the private car if these are easier to use and faster. So, the number of passengers in public transport is expected to increase if the conditions of those transport options are improved.

- An efficient intermodal transport system, that combines different kinds of transport in an easy and simple way, will contribute to less time spent in commuting/travelling - mentioned as an important factor when choosing between public transport and private car (Beirão & Cabral, 2007).

1.3 Dissertation Structure

The present dissertation is divided in six chapters.

The first chapter, Introduction, presents the context of the study, define the research scope, the main objectives and presents the structure of the dissertation.

Chapter two describes the state of art in urban mobility and intermodality systems. This is based on literature review, including earlier works developed on the scope, main studies and relationship between them.

In third chapter is described the adopted methodology, the details about data collection and treatment and justifications to the study case choices developed in the following chapter.

In chapter four are presented the case studies, which compares Lisbon transport systems with the ones in Brussels. At first, is described the context of which city and then is done the analysis of surveys and interviews.

Chapter five are discusses some strategies to improve passengers' intermodal systems in Lisbon, based on the precedent analysis and literature review.

In the last chapter are presented the main conclusions, responding to the objectives, identifying the limitations and proposing future developments.

2 LITERATURE REVIEW

In this chapter are presented the state of art in urban mobility and intermodality systems, including earlier works developed on the scope.

2.1 Urban Mobility

Urban mobility is one of the toughest challenges that cities face today as a consequence of both congested cities and the increasing world population living in urban areas (Arthur D. Little, 2014; EC, 2009). A large majority of European citizens live in an urban environment, with over 60% living in urban areas of over 10.000 inhabitants, and for their mobility they share the same infrastructure (EC, 2015).

Transport networks and services allow people and goods to move between different points in space, providing accessibility (Stasio et al., 2011) and mobility. In the last half century, authorities have improved accessibility by having better roads and new motorways. As a result, private transportation became the main mode of transport. The undesired consequences of private transport such as congestion and pollution, but also fossil fuels consumption and GHGs emissions, have however prompted authorities to promote the use of public transport (Stasio et al., 2011).

Cities need efficient transport systems to support their economy and the welfare of their inhabitants (EC, 2009). The awareness about the benefits of a good urban mobility has been increasing among Europeans (EC, 2007).

2.1.1 Modes of Transport

In an urban mobility system there are different modes of transportation, divided in two main groups: non-motorized and motorized.

The soft modes that includes all forms of non-motorized transportation, like cycling and walking, are the most sustainable modes of personal transport. They provide positive health benefits while reducing congestion and averting the need for vehicles at the same time, contributing to the reduction of air pollution and noise in cities (Heinen et al., 2010).

When regarding motorized transportation, public transport, like train, bus, metro, tram and ships, follows close behind in the hierarchy of sustainable transport modes.

Motorcycles and cars are other examples of motorized transport modes. The car is rapidly adopted as mobility mode when income levels reach a certain threshold, as referred more convenient than other transport alternatives. The automobile or others private forms of transportation are important to the urban mobility and should not be discarded (Rodrigue, 2013).

2.1.2 Different Stakeholders in Urban Mobility

There are different private and public actors involved in urban mobility with different competences and responsibilities.

The responsibility for urban mobility policies lies primarily with local, regional and national authorities. Nevertheless, decisions adopted at local level are not taken in isolation but within the framework provided by national, regional and EU policy and legislation. Public authorities have an essential role in providing the planning, the funding and the regulatory framework. The EU can stimulate authorities at local, regional and national level to adopt the long-term integrated policies that are very much needed in complex environments (EC, 2009).

Last but not least, the transport service providers, including transport operators and road owners, and citizens are also important actors in urban mobility ecosystems (Transforum Project, 2014).

The several urban transport stakeholders are important in fulfilling the urban transport goals (Transforum Project, 2014) and for this reason their views should be taken into consideration when defining mobility policies or practices.

2.1.3 Environmental Impact

Mobility in cities and towns has several environmental impacts, such as air pollution and noise pollution (EEA, 2013). Motor vehicles are one of the largest sources of pollution worldwide. European cities increasingly face problems caused by transport and traffic. Up to a third of Europeans living in cities are exposed to air pollutant levels exceeding EU air quality standards (EEA, 2012) and one of the main sources is transport. Transport represents around 25 % of all the CO_2 emissions responsible for climate change, almost all attributed to road transport (EEA, 2013). Urban mobility accounts for 40% of all CO_2 emissions of road transport and up to 70% of other pollutants (NO_X, SO_x, PM_{10}, $PM_{2.5}$, CO, NH_3 and NMVOCs) from transport (EC, 2007).

Air quality in cities is of major importance to human health. Furthermore, transport has a serious impact on the landscape because it fragments natural areas into small patches with serious consequences for animals and plants (EEA, 2014c).

The “slow, stop and start” element of congested urban traffic conditions and frequent short journeys can increase fuel consumption by 30 % and result in higher air pollution emissions per kilometre compared to free-flowing longer journeys (EEA, 2012).

In the Green Paper - Towards a New Culture for Urban Mobility one of the five main challenges to cities and towns are the reduction of congestion (EC, 2007). It has become clear that congestion cannot be managed just by adding road capacity. An increasing number of cities are applying integrated approaches to tackle congestion, including measures related to access restrictions, parking standards and pricing policies, land use planning and improving non-motorised

facilities and public transport services (EEA, 2013). Furthermore, urban planning plays an important role in both reducing the length of car trips and increasing the modal share of walking, cycling and public transport (Tønnesen, 2015). By making cities friendly to pedestrian, safe and wide access to non-motorized vehicles, expanding public infrastructures and improving existing public transit services , makes possible to expand and improve the transportation in urban areas in such a way that automobile become only part of the equation rather than the focus (Rodrigue, 2013).

2.1.4 Sustainable Mobility

The need for more sustainable cities has long been on the political agenda due to the growing share of the global population in urban areas (Rodrigue, 2013; Tønnesen, 2015). Therefore, urban mobility has a role to play, with the transport sector identified as crucial in the reduction of GHG emissions (Tønnesen, 2015). Moreover, urban mobility is also an important facilitator for growth and employment, strongly impacting the sustainable development of towns and cities (EC, 2007).

The World Business Council for Sustainable Development (WBCSD), on its report Mobility 2030, defined sustainable mobility as "The ability to meet society's desires and needs to move freely, gain access, communicate, trade and establish relationships without sacrificing other essential human or ecological values, today or in the future" (WBCSD, 2004). The concept of sustainable mobility assumes that citizens living in cities, towns or villages dispose of conditions and accessibility and mobility choices that give them safe, comfortable, with acceptable times and affordable travels. It also implies that their mobility is exercised with energy efficiency and reduced environmental impacts (IMTT, 2011).

The following factors are related to sustainable mobility:

- Economic: productivity, operational activities, employment, taxation, trade etc.;
- Social: social equity, public health, quality of life, cultural and historical values, citizen participation, etc.;
- Environment: emissions, climate change, biodiversity, natural environment protection, aesthetics, etc. (Pitsiava-Latinopoulou & Iordanopoulos, 2012).

2.1.5 Optimising Urban Mobility

Current mobility systems adapt poorly to changing demands, are weak in combining single steps of the travel chain into an integrated offering, find it difficult to learn from other systems, and avoid an open and competitive environment. Collaboration among the different transport stakeholders on solutions is rare. Rewards for investors are rather meagre. Moreover, a lot of mature cities do not yet have a clear vision and strategy on how their mobility systems should look in the future (Arthur D. Little, 2014). According to Arthur D. Little (2014) and EC (2009) the following points are needed to improve urban mobility:

- Urban mobility plans with a clear reflection on the synergies between isolated initiatives (that can lead to optimal outcome in terms of mobility performance) or incompatibilities between the initiatives.
- Integration between the different modes of transportation and a convincing explanation of how desired results should be achieved by allotting responsibilities, setting deadlines, and instituting monitoring procedures.
- Effective integration, interoperability and interconnection between different transport networks are key features of an efficient transport system.
- Interlink between urban mobility strategies and other urban strategies.
- Involve the private sector in the achievement (setting process) of urban mobility goals: decisions should not be mainly based on "public sector actions".
- Stronger integration between regional mobility systems strategies while respecting each other accountabilities and ensuring solutions are adapted to local contexts.
- Affordable and family-friendly public transport solutions are key to encourage citizens to become less car-dependent, use public transport, walk and cycle more, and explore new forms of mobility, for example in the form of car-sharing, carpooling and bike-sharing.
- Employers and public administrations can provide support through financial incentives and parking regulations.
- Company mobility management can influence travel behaviour by drawing the employees' attention towards sustainable transport options.
- Alternative means of transport such as electric bicycles, scooters and motorbikes as well as taxis can also play a role.

2.2 Intermodality

2.2.1 Concepts

Intermodal passenger transportation is a complex subject which consists of various sub-subjects and related issues. This section provides an overview of the intermodal ecosystem, the information and ticketing systems.

It should be noted the differences among some important concepts such as intermodality, multimodality and co-modality, which are explained below.

Intermodality is both a technical term for a specific type of journey including several modes of transport and a policy principle. The passenger intermodality can be defined as an intermodal passenger travel, in a seamless door-to-door travel using several transport modes. As a concept it

can be seen as a combination of transport specific advantages for a safer, cleaner, more comfortable and more efficient transport system (LINK project, 2010).

Multimodality refers to the use of different modes of transport at different opportunities, for different trips. For instance, using the bicycle to go to work and the taxi to go to the opera. It is also a policy principle meaning not to stick to one single mode (EPOMM, 2011; LINK project, 2010).

Co-modality is a notion introduced by the EC and it refers to the efficient use of different modes on their own and in combination in order to obtain an optimal mobility outcome in terms of travel effort as well as transport sustainability and supply efficiency (LINK project, 2010; Stasio et al., 2011). Co-modality recalls the principle that "public transport operates most successfully when it is planned as a unified network to support seamless multi-destination travel rather than as individual lines catering to single trips" (Stasio et al., 2011).

2.2.2 Intermodal Ecosystem

The car often remains the primary means of transport in towns and cities (Cramer, 2009). One of the reasons for people keep using their cars, even when cheaper, faster and more convenient alternatives exist, is the ease-of-use and flexibility of the private car (EPOMM, 2011). Cost alone has a relatively low impact in determining a person's transport choices (Cramer, 2009). One major cause, why inducing mode shift from private cars to public services is difficult, is because public transport is often considered to be a greatly inferior option in terms of reliability and availability, suppling a lower accessibility level than car (Cramer, 2009; Stasio et al., 2011).

No single sustainable mode has the image of covering traveller's mobility needs like the car does (EPOMM, 2011). One possible strategy to improve accessibility by public transport is to extend the possibility to use public modes in various combinations or even in combination with car (Stasio et al., 2011). Only in combination, sustainable modes can be a truly attractive alternative to the private car (EPOMM, 2011). The basic idea is that even if one public transport network (e.g. rail) alone cannot provide high accessibility, an integrated use of different networks can (Stasio et al., 2011). Therefore, intermodality is an integral part of the sustainable mobility and is of vital importance particularly in high congested urban areas (Pitsiava-Latinopoulou & Iordanopoulos, 2012).

In that context, some of the solutions to reduce congestion in urban areas are to make alternatives to private cars attractive and safe. This includes public transport, car-pooling, walking and cycling. Other solutions may include Park and Ride facilities, urban charging schemes, better traffic management and information, and efficient freight transport (EC, 2007). Intermodality can contribute to an integrated and efficient transport system which will establish networks of interconnected modes, where transfers from one mode to another are easy and comfortable, offering more options to the travelling passenger (EC, 2004).

In the future, urban mobility services will be driven less by improvements in single transport modes and more by their integration (Arthur D. Little, 2014). New intermodal mobility strategies have to address the reliability and availability of public transport. They must be based on an acceptance that the private car is the benchmark and create an intermodal system that can stand comparison, at least in terms of functional equivalence but ideally in terms of standards of comfort too (Cramer, 2009).

2.2.2.1 Intermodal Passenger Interchanges

Intermodal interchanges or intermodal terminals, where different transport modes are combined, represent a key part of the passenger journey. The quality of the interconnectivity is then a major requirement (Stasio et al., 2011). An integrated and efficient design of intermodal passengers' terminals, which act as the interface between the different modes, could lead to the increase of the share of commuters who use urban public transport as well as to the consolidation of the overall public transport system of an urban area (Pitsiava-Latinopoulou & Iordanopoulos, 2012).

The effectiveness of a terminal in terms of intermodality is not only subject to the number of public transport modes serving it but also to the level of connectivity provided. The latter is highly related with the spatial location of each mode's access platforms and the synchronization of their services (Pitsiava-Latinopoulou & Iordanopoulos, 2012).

In the case of "Park and Ride" facilities, in order to increase the connectivity with private transport, is necessary mostly in the cases where the terminal is located in sparsely populated areas in proximity to urban major arteries and not in the city centre, where they remain underused (Pitsiava-Latinopoulou & Iordanopoulos, 2012).

A smooth transfer from one network to another is a matter of physical connections but also of functional and organisational aspects like e.g. integrated services and ticketing (Stasio et al., 2011).

Moreover, a passenger friendly interchange needs to provide up-to-date travel information, provide safe and clean waiting facilities and ensure that the layout of the interchange is easy to understand for visitors. Besides that users need to perceive that the interchange is a safe place to be, not just for them but also for their bicycles and other equipment. A poor planning and location of interchanges with poor transfers is seen as a barrier to intermodality (EC, 2004).

2.2.2.2 Cooperation and Intermodality

In general, the various transport networks (infrastructure and services) are owned and/or operated by either public or private organisations, which in many cases compete against each other for a share of the transport market. Consequently, each transport company endeavours to optimise the building and operation of its own network and transport services (Stasio et al., 2011).

The International Association of Public Transport (UITP) believes that, to keep up with the needs of modern urban life, public transport should develop intermodal strategic partnerships and alliances with all transport providers, including taxis, bikes and car-sharing, parking facilities, information providers and all major mobility generators (UITP, 2011). Interoperability of systems and collaboration between providers is essential (EPOMM, 2011). In order to achieve an efficient intermodal passenger system it is needed a system-level collaboration between all actors of the mobility ecosystem to come up with innovative and integrated business models (Arthur D. Little, 2014).

Transport services of different public and private operators need to be coordinated to meet the passengers demand for a flexible, convenient and fast transport system (EC, 2004). A convenient integrated offer can attract new users and cause modal shift and enhance visibility of all providers involved. So, this is a win-win situation for both operators and authorities (EPOMM, 2011).

As a mode transfer results in a loss of comfort and/or time or involves a higher cost, interchanges are central elements within this field. Their quality in both physical design and operational integration has a very strong influence on the quality of the intermodal journey (EC, 2004).

2.2.2.3 Cycling and Public Transport

Bicycles are a great way to achieve the goal of sustainable mobility patterns in several ways (UITP, 2011). The combination of bicycle usage and a transit system could thus be a competitive alternative to private vehicles because it is able to provide seamless connections (Cheng & Liu, 2012).

More and more services are developed to cater for cyclists switching to public transport, both in the field of infrastructure and of additional services, supporting intermodality (EPOMM, 2011).

Cycling supports public transport by extending the catchment area of public transport stations far beyond walking range. It enlarges the public transport offer in time (24/7 service) and geographically (where the public transport offer is low) and contributes to giving public transport a fresher and healthier image (UITP, 2011).

To encourage cyclists to use public transport it is important to build safe bicycle facilities next to public transport stops. Bike-and-ride parking facilities cost much less than “Park and Ride” facilities for cars. Through coordinated pricing, ticketing and marketing, the integration of cycling into the public transport offer will increase customer loyalty and attract new customers (UITP, 2011).

In recent years, bike sharing schemes have made cycling a popular way to get to final destination. As there are ever more bike sharing schemes in operation, bicycles are no longer exclusively personal mobility modes. As a result, bicycles are increasingly seen as the solution of choice for the first and last mile issue (UITP, 2011).

2.2.2.4 Carpooling and Car Sharing

Vehicle-sharing systems are becoming popular as a new mode of mobility. Since some parts of certain journeys will always require the use of a car, carpooling and car sharing have become essential in a sustainable intermodal and multimodal transport system (EPOMM, 2011).

The integration of car sharing and carpooling into transport strategies, by the development of strong alliances between the sharing operators and the public transport operators and/or the public transport authorities, gives the opportunity to offer people the whole range of mobility. This allows public transport to have a more dynamic image, introducing greater flexibility and wider mobility offer. This innovative element turns public transport into a more attractive option, with a direct impact on the environment and congestion, as it ensures that fewer cars are on the road (Huwer, 2004; UITP, 2011).

The success of combined mobility depends, not only on forward-thinking public transport operators, but also on the formulation of a strong partnership with the government bodies to create the preconditions for car sharing (Huwer, 2004).

2.2.3 Information Systems

The EC First Report of the study "Towards Passenger Intermodality in the EU" mentions that door-to-door information systems, both pre-trip and on-trip, are a key issue to enhance intermodality (EC, 2004). Moreover, as a way to enable passengers to make efficient use of a seamless intermodal transport offer, the information, besides of being intermodal, needs to be real-time, widely available and include predicted arrival times (EPOMM, 2011).

The information about public transport must start when entering the city, linking long distance transport with urban mobility. So, information about transports options on the flight and accessibility at the airport of destination are some of recommendations to a good intermodal mobility system (LINK project, 2010).

In order to attract more passengers, transit service must not only have a high level of service in terms of frequency and travel time but also must be reliable (Watkins et al., 2011). And real-time information in mobile terminal equipment, in the hands of passengers or on displays at stations and bus or tram stops can combat the perception of unreliability from the user perspective (Cramer, 2009; Watkins et al., 2011). In various studies, travel information service has been indicated as important and hence it can substantially contribute to the overall satisfaction with public transport quality (Grotenhuis et al., 2007).

Technology is an important tool to the progress in passenger information and the technology to provide high-quality passenger information systems is already widely available (EC, 2004). Information supplied to potential users via the internet and smartphones is improving transport effectiveness in two major ways. First, it is informing travellers about the different integrated

public transport options using real-time accurate information. Second, since most cars are occupied by a driver only, a market can be set up for potential drivers to meet potential passengers in an effective ridesharing scheme, in which authentication, micro-payments and effective coordination can be executed using real time hub and mobile phone technology (Cebon & Samson, 2011).

Dynamic at-stop real-time information displays are becoming more and more abundant in modern public transport. And reactions and attitudes towards these systems are very positive. The seven main effects that these kinds of displays can have on customers are: reduced waiting time; positive psychological factors, such as reduced uncertainty, increased ease-of-use and a greater feeling of security; increased willingness-to-pay; adjusted travel behaviour such as better use of wait time or more efficient travelling; mode choice effects; higher customer satisfaction; and finally, better image (Dziekan & Kottenhoff, 2007).

The quality of information about a particular public transport system and the ease of access to information are relevant factors to make public transport more attractive and may enhance more sustainable behaviours that promote energy efficiency in the transport system, the reduction of pollutant emissions and a better quality of life (IMTT, 2011).

Many cities and regions are working on ways to provide high quality information system and some of them are having success. However, on the other hand a lot remains to be done to create a trip planner that integrates all available modes and suggests truly intermodal journeys across all modes (EPOMM, 2011). According to *Instituto da Mobilidade e dos Transportes Terrestres (*IMTT – current IMT), a quality information system, directed to the user of mobility transports/services, must follow the different characteristics presented on Table 2.1.

Table 2.1 - Characteristics of an information system of quality (IMTT, 2011).

Characteristics of an Information system of quality	Be clear and easy to use
	Meet the needs of different user groups (with different capacities when it takes to the use of new technologies or with special mobility difficulties)
	Using one or many forms of communication simultaneously through human contact, via alphanumeric and graphical traditional media (maps) and static and dynamic electronic platforms
	Integrate information on all transport modes and the links between them
	Integrate information about not only the classical systems of public transport as well as on existing complementary mobility services (flexible transport, carpooling, car sharing, collective taxis, bike-sharing) and urban information and cultural and tourist interest
	Vehicular timely or real time: information on accidents caused by service interruptions, works on infrastructure, breakdowns; disclosure service changes and of new services; information on tariffs; information on traffic conditions, parking and arrival time of the service

Furthermore, the EC on its "Action Plan to Urban Mobility" agreed to work with public transport operators and authorities on facilitating the provision of travel information through different media. Also supporting the development of national and regional multimodal journey planners, and links between existing planners, with the ultimate aim of providing users with a public transport travel portal at EU level on the internet (EC, 2009). A passenger information systems that integrate all European transports is the goal, as a way to promote a more sustainable behaviour travel all over Europe.

2.2.4 Ticketing Systems

The ticketing system of a transport network available in a certain region is important to facilitate intermodality (EPOMM, 2011; LINK project, 2010). Integrated ticketing can be defined as the purchase of a single ticket that allows passengers to travel on one or more modes of transport provided by one or more operators. It is an important component of the broader concept of integrated transport (EP, 2012). Simple and comfortable combined ticketing and integrated pricing of different public transport providers is essential for making public transport attractive. Another challenge is to incorporate other modes like bike sharing and car sharing into a unified ticketing system (EPOMM, 2011). The main aim of integrated ticketing is to improve service quality for (potential) public transport users and therefore to encourage the use of alternatives to the car (Puhe, 2014).

The notion of ticketing integration has been supported by the EC since the adoption of the White Paper on transport policy in 2001 and yet it remains an ambitious objective. Together with integrated charging and fares, the promotion and development of integrated ticketing schemes between transport service providers is perceived as a building block in achieving seamless mobility (EP, 2012). Ideally, there will be one national, or even European-wide multi-modal ticketing system (EPOMM, 2011).

2.3 Intermodality in European Cities – Best practices

Several intermodality measures have been emerging and have been implemented across Europe during the last years. It is visible the efforts that have been done to achieve intermodality in passenger commuting journeys. In the following points are presented some of the best practices for intermodal passenger mobility. To help the reader, it was organised by country, theme and, depending on the measure, by region or city.

2.3.1 Belgium

Theme: Intermodal System

Region: Wallonia

In the Belgian region of Wallonia, passengers can subscribe to a season ticket for the bus that includes the rent of a folding bike called CycloTEC (Figure 2.1). In order to use this service, in addition to the cost of the season ticket, passengers have to pay 60 Euro a year, what include the rental of the folding bicycle, annual maintenance and insurance (TEC, 2015).

Figure 2.1 - CycloTEC, folding bike provided to bus users (TEC, 2015).

This service started in May 2010 and in 2012 had 500 bicycles available for passengers and 120 in use (Binet et al., 2012; SRWT, 2010). The reason for lack of success seems to be the lack of continuous infrastructure for cyclists. However, they continue to move forward with the CycloTEC to bring behavioural changes (Wauthy, 2013).

2.3.2 Britain

Theme: Intermodal System

Region: Greater London

Transport for London (TfL) is a good example of a strong and integrated regional authority which controls all aspects of mobility in a city: not only mainstream modes such as metro, tram and buses but also taxi regulation and licensing, the promotion of walking and cycling and responsibility for the cities' principle roads (Arthur D. Little, 2014). TfL supports multimodality and hopes to increase the modal share of cycling in London to relieve the overcrowded metro and buses (EPOMM, 2011).

Theme: Information System

City: London

The Legible London is an easy-to-use signage system that presents information in a range of ways, including maps and directional information, to help people find their way easily around the city. It is integrated with other transport modes, including bus stops, metro stations and taxi ranks, so when people are leaving one mode of transport they can quickly identify their onward route, preferably by foot. Legible London details the landmarks they will pass on their journey and shows the time it will take to reach their destination. Legible London is already working successfully across London, with more than 1 300 signs, a research shows that nine out of ten people were keen to see more Legible London signs introduced. So, TfL is now working to expand the scheme further (EPOMM, 2011; TfL, 2015).

Theme: Ticketing System

City: available in 260 cities across Britain

In Britain there is a ticket that integrates long distance travel with the last urban mile, its name is PLUSBUS.

PLUSBUS is a discount price bus ticket that train travellers buy with their rail ticket. It gives unlimited bus travel on participating buses around the town, at the start, finish, or both ends of their journey. The main objective of PLUSBUS is to encourage train travellers to use local buses for the journey to their origin rail station and also to complete the "last few miles" of their journey from their destination station to their final destination. The main benefits for travellers are the convenience of being able to buy tickets for their entire journey in one transaction and getting discount price bus travel. To make it easy for travellers, PLUSBUS has one price per day for each town (PLUSBUS, 2015).

PLUSBUS demonstrates that private commercial bus and train operators can work together, even in a competitive environment, to introduce integrated ticketing solutions, without the need for central Government to control, finance or legislate (LINK project, 2010).

2.3.3 Denmark

Theme: Intermodal System

City: Copenhagen

In Copenhagen, it is possible to bring a bike on metro, train and onboard of some buses. In 2010, Danish State Railways implemented a new measure allowing the bicycles to travel for free on the red S-trains that serve Greater Copenhagen and suburbs. The aim of this measure was to make every day journeys easier for Copenhageners and encourage more people to use their bicycle (Colville-Andersen, 2010).

When to take the bike on the regional trains around Copenhagen, on the metro or on the bus is needed an extra bike ticket (Visist Copenhagen, 2015). In Figure 2.2, it is possible to observe the integration of bicycles in trains, with visible bicycle pictograms to inform passengers about where to load and to carry the bicycles on the trains.

Figure 2.2 – Integration of bicycles and red S-trains in Copenhagen (Restrepo, 2012, and Loomans, 2014).

Theme: Information Systems

City: Aalborg

Aalborg developed two mobile phone applications making it easier for public transport users to plan their journeys in the city. The municipality expects that the service will increase user satisfaction and may attract new passengers including tourists who are not familiar with the public transport system. Aalborg provides mobile phone users with GPS-based real-time passenger information. The system is able to locate nearby transport options and includes links to the national travel planners. The "Take Me Home" applications guides users home by public transport, and the mobile portal "NTmobil.dk" integrates information on different public transport services.

Aalborg already implemented real-time passenger information at some bus stops in the city. This was very popular and is now being developed further. The mobile phone services let users access real-time passenger information for all stops, also those that have not been equipped with those displays yet. The main objectives of the measure are to increase public transport user satisfaction and attract new public transport users.

The mobile application integrates the following functions: GPS based search and presentation of real-time information from the 30 nearest bus stops, Travel planning "from here" based on mobile phone GPS and "Take me home" travel planning based on GPS position as departure and predefined home address as destination.

In 2011, the public transport authority of north Denmark (Nordjyllands Trafikelskab) and the City of Aalborg have conducted a major advertising campaign by using several types of media to inform the passengers on the "Take me home" application. Among others three small YouTube movies showing situations where a GPS-based "take me home" application is very appropriate. These videos are also a part of the content on the Information screens in the buses (CIVITAS, 2013a).

Theme: Information System

City: Aalborg

Aalborg aims to increase the use of public transport and is working towards making the service more attractive. In that context, it was implemented flat screen monitors on buses with real time travel information about current trip and transfer possibilities (Figure 2.3). The service displays the destination and upcoming stops, as well as the weather forecast, news and advertisements.

Figure 2.3 - Real time information display on a bus in Aalborg (CIVITAS, 2013b).

The user surveys show that almost all passengers consider the screens and information as a service improvement and are satisfied with the way the information is presented. Almost two thirds of the passengers think it is all right that advertisements are shown in between the information.

The system will also be expanded with further information from local service providers such as Visit Aalborg, the Sportsarena etc. and with new types of (dynamic) information such as real-time information on train and flight connections to and from Aalborg being displayed on relevant bus lines (CIVITAS, 2013b).

2.3.4 Estonia

Theme: Information System

City: Tallinn

In order to attract more passengers to the public transportation system, a measure was initiated to improve passenger information systems throughout the collective transport fleet, mainly by adding electronic displays onboard vehicles and at stops and adding equipment for automatic bus stop calls. The new information systems aim to provide real-time information for the passenger through the use of on-board displays, showing route numbers, destination, stop names and connection information. Other features include exterior displays showing line number and route information, and an automatic bus stop-call system which provides audible information concerning the name of the upcoming stop and what connections are available for an onward journey. With the new changes, the city hopes to increase the number of collective transport passengers. The information systems are also expected to increase the number of disabled people who use public transport by 100% and increase user satisfaction by between 35-60% (EC, 2007).

2.3.5 France

Theme: Intermodal System

City: Chambéry

In 2002, a large bike station was built near the railway station to boost the number of intermodal trips. It offers additional services like guarded bike storage, free bicycle check-ups and bike rent. On several locations and park and ride facilities in the wider region, bike boxes were installed for people who come into the city by car and would like to switch to the bike at a certain point. The bike station proves to be a success especially amongst students, generating over 100 000 rented cycling trips every year. The guarded bicycle storage service caused an important increase in multimodal trips (train and bicycle) throughout the city, causing CO2 emission savings of almost 64 tons a year (Bossaert, 2014).

Theme: Information System

Region: Basse-Normandie

An example of a journey planner that includes a lot of different modes and operators is the website *Comment j'y vais* (http://www.commentjyvais.fr). It actively promotes carpooling when users request an itinerary for a starting point or destination that is more than 5km from a public transport bus stop, and walking or cycling for less than 5km (EPOMM, 2011).

City: Strasbourg

Strasbourg has integrated real-time information for different modes (parking, car sharing, bike sharing, cycling, public transport) in one interactive website www.carto.strasbourg.eu . (EPOMM, 2011).

Theme: Ticketing System

Region: Rhone-Alps

In the French region of Rhone-Alps, travellers can load transport tickets from different networks on the same "OùRA! smart card", sometimes at multimodal rates. The same card can be used for related services like bike rental, bike parking and car park access (EPOMM, 2011).

City: Nantes

Transport provider TAN in Nantes has created a ticketing system easy to understand and user friendly. Passengers can choose between a 1h ticket or a 24h ticket that gives them access to all modes in the greater Nantes (tram, bus and the trains of operator TER). Other tickets exist that also include access to the transport offer in the wider region (EPOMM, 2011).

2.3.6 Germany

Theme: Intermodal System

City: Bremen

Bremen is one of the precursors of car sharing in Europe. Since 2003, they have installed ten intermodal car sharing stations in the city, called "mobil.punkte" (mobile points). They are each located near a public transport stop and include bicycle racks and sometimes a taxi stop. Besides that, there is multimodal travel information available at each station (EPOMM, 2011).

Theme: Ticketing System

City: Hannover

The "HANNOVERmobil card" is a season ticket for the local transport network of the greater Hannover that is upgraded to a full-blown mobility card for an extra 6.95 Euros a month. It gives access to car sharing and a discount on taxis, car rental, a bicycle parking in the city centre and the German railways. All transactions made with the card, are charged at the end of the month in one common "mobility bill" (EPOMM, 2011).

Theme: Information and Ticketing Systems

City: Stuttgart

Stuttgart Services project aims at the integration of electric vehicles with other sustainable modes of transport and the promotion of intermodal mobility. The backbone of integrated mobility offerings in the city is public transport. Two main outcomes are:

- Mobility card "Stuttgart Services": The integrated mobility card gives the customer the ability to use different services and means of transport in a fuss-free way. It removes the need to carry different cards for different services, a clear value proposition for customers.
- Integrated mobility platform and app: provides real-time intermodal information, serves as an information/planning tool and as a booking and reservation system.

By creating intermodal mobility solutions, an ambitious vision is becoming a reality in Stuttgart. The attractiveness of eco-friendly mobility services has been increased. Public transport, car sharing and bike sharing are being pushed and a sustainable, integrated mobility eco-system is being built. This serves to increase the quality of life of the citizens and promotes the attractiveness of the entire region (Arthur D. Little, 2014).

2.3.7 Luxembourg

Theme: Intermodal System

In Luxembourg a new parking police were implemented. Some measures included on it are "Park and Ride" facilities at several locations around the city, together with frequent public transport connections to the city centre. The measures have discouraged commuter traffic and long term parking in the city centre, reduced commuter parking in residential areas, and has introduced efficient parking management through a clear system of parking zones. As a result of the implementation of the measure was observed a drop in car traffic and an increase in buses by some 80%. No negative impact was felt on the city's economic activity (EC, 2007).

2.3.8 Portugal

Theme: Intermodal System

City: Funchal

In Funchal citizens are sceptical to cycling due to the hilly geography of the city. In the framework of the CIVITAS program however, bicycle racks were added to the back of vehicles of some bus lines (Figure 2.4), allowing cyclists to take their bike on the bus for free (EPOMM, 2011).

Figure 2.4 -Bicycle rack on Funchal bus, Portugal (CIVITAS, 2013c, and Koehn, 2014).

2.3.9 Slovenia

Theme: Information and Ticketing Systems

City: Ljubljana

The measure intended to include integration of information systems, fares and timetables of all public transport operators. However, because of the late introduction of national standards for e-ticketing, it had to be modified. Nevertheless, the new system is an innovation for operators on the local and regional level and a complete novelty to passengers, who are able to plan journeys online and travel with one ticket on all transport modes.

Previous differences in timetables, fares and services have made the system difficult to understand and frequently caused some trouble. As a result Ljubljana decided to make public transport more user-friendly, fast and attractive by integrating information systems, fares and timetables of the entire public transport system.

The public transport portal with information for train and city bus has been established on Google Transit and is used to plan trips with public transport. It is an innovation on the Slovene market and a complete novelty to passengers, who are travelling from other parts of Slovenia to Ljubljana. Passengers are also able to buy and charge the contactless card "Urbana" on major train stations throughout Slovenia. The main objectives were:

- To join global public transport route planner system (Google Transit);
- To expand the selling network of the city contactless card "Urbana";
- To run a pilot project on integrated public transport for Ljubljana and some suburban zones;
- To make public transport more attractive and increase the use of public transport.

The integrated city card was introduced as a payment tool and later as a ticket for the city area that will through a pilot project be expanded to the region. In the future, the results may even be used for implementation at state level or beyond. Based on electronic ticketing technology passengers can purchase tickets via a new modern payment system including M-Pay technology that provides cashless payment via mobile phone. The city also created a common website (Google Transit) that offers travel information for the entire public transport network in the city and enables route planning in Ljubljana.

Ljubljana adjusted the conditions and fare systems of the public transport operators, as well as payment systems and distribution channels as the basis for an integrated system in the future. The compatibility of different ticket forms, for instance SMS, is checked with the public transport operators. All buses are equipped with the technology to facilitate the new system. If successful, the city may adopt the system at state level.

During the project, all bus stops were equipped with exact dispatch information for that particular bus stop. So, passengers know exactly, when the buses are dispatching from each bus

stop. On some more important bus stops new panels were installed, on those there are displayed city maps and some additional information important for the passengers.

Outcomes of the measure: Almost one quarter of survey respondents are using the planning service Google Transit at least occasionally after nine months availability (since September 2011). The ticketing system integration by two bus service providers, urban and suburban, was very well accepted by the regular public transport users from suburban area, with on average 34 000 users per month and an increasing trend of additional 600 users per month (CIVITAS, 2013d).

Theme: Ticketing System

City: Maribor

In the ski resort of Maribor, car trips were reduced by offering to the holders of a ski pass a free bus ride to the ski lift (EPOMM, 2011). The aim was to stimulate the use of public transport and offer its citizens and tourists a new, cheaper and more sustainable way of transportation to their destinations (Toplak, 2015).

2.3.10 Spain

Theme: Information System

City: Donostia - San Sebastián

Reliable real-time travel information for bus passengers was the goal of this measure. The city made this information available to all citizens, even the visually impaired, through a range of technologies. The main objectives were to:

- Increase the reliability and availability of travel information;
- Make this information accessible to the visually impaired;
- Increase the number of public transport passengers.

Real-time information is provided in buses, at bus stops through electronic boards, via SMS messages and online. A new website containing public transport information was developed, using accessibility technology so that the information can be understood by the visually impaired. This measure was closely linked to the introduction of a new bus management system, within which important new data sources were implemented, such as a new passenger counting system and the use of WIFI technology for determining the location of vehicles.

The new travel information system was implemented, providing real-time information such as arriving bus line, waiting times, connections, eventual incidents in the service, through the following means:

- Real time information system onboard of the buses announcing next stop and connections
- Provision of bus arrival times by SMS messages.
- Provision of bus arrival times via Bluetooth.

- Electronic information panels at bus stops providing information on arriving busses, waiting times and eventual disruptions or re-directions of the services.
- Renewed web site including real-time information at bus stop level and a route planner.

The traveller information system was very successful, with more than 3,500 daily requests for real-time information via SMS or the website during the project life. The provided information was highly reliable, with 98.1% of all the information requests assessed by the users as correctly answered. In addition, 60,000 users had access to real time information at the bus stops through electronic boards. Surveys revealed that information issues were perceived as very important by the users, with an average score of 8.47 out of 10. User demand for quality information services was therefore very high (CIVITAS, 2013e).

2.3.11 The Netherlands

Theme: Intermodal System

The public bike called "OV-fiets" is a very successful national service managed by the Dutch railways, managing about 5000 bicycles achieving almost 1 million trips per year. The brand emphasises the integration of the bicycle and public transport. If the passenger already owns a train card, an additional subscription card is not need. A new service called OV-fiets@home allows commuters to take a public bike home in the evening and return it the next morning. They can also keep it for the weekend. This type of subscription costs just 15 Euro a month (EPOMM, 2011).

Theme: Intermodal System

City: Amsterdam

The Park and Ride concept is usually more associated with the connection between cars and public transports. However, in Amsterdam this principle was applied to cars and bicycles where a Park and Bike system exists. There users can park their car and hire a bike in the same location (EPOMM, 2011).

Theme: Information System

City: Amsterdam

The connection between cycling and ferry boats has been optimised by placing dynamic information panels that display departure times of three to four ferry boats. They are installed far enough so cyclists can still adjust their speed in order to catch a ferry that is about to leave (EPOMM, 2011).

3 RESEARCH METHODS

3.1 Methodology Process

The methodology of the present dissertation is illustrated in Figure 3.1 and can be divided in three main phases:

- The first phase of the study is focused on literature review;
- The second on the analysis of two case studies, and;
- The last phase on proposing strategies to improve intermodality in the city of Lisbon.

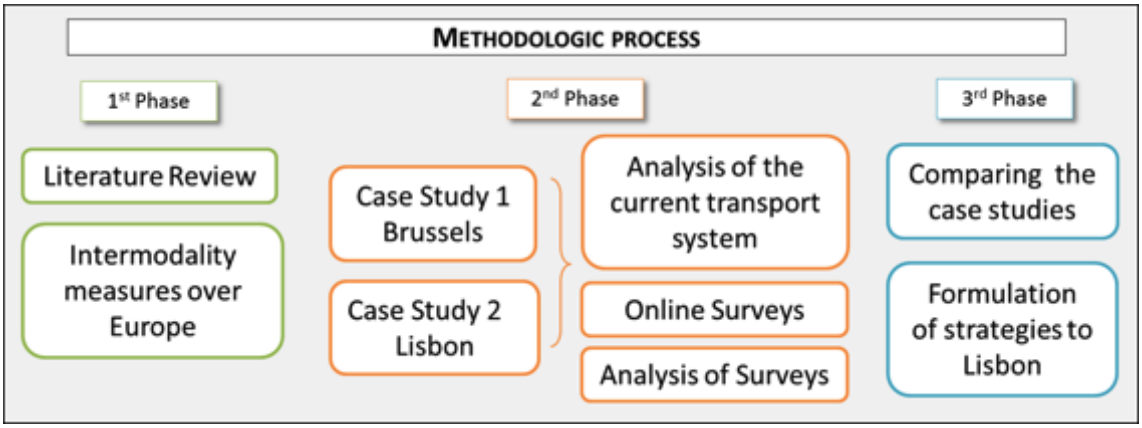

Figure 3.1- Methodologic process (Nádia Pedroso, 2015).

3.2 Literature Review

The analysis of the literature was prepared with the aim to serve as basis for the rest of the present dissertation. In order to do that a documentary analysis of articles, studies and organizations reports was done. The websites of transports operators and of main organizations in the field of the study were also consulted.

Urban mobility and intermodality concepts are presented even as the actual tendency in urban mobility policies and practices, indicating the impacts of mobility to the environment and sustainability, to demonstrating the relevance of the present study.

Moreover, a review of some of the most recent mobility practices/measures taken mainly in European cities was done. Further in the work, it is evaluated the possibility of applying some of that measures to the city of Lisbon with the necessaries adaptations.

3.3 Case Study: Comparing Brussels and Lisbon

In the present study the city of Brussels and Lisbon were chosen as cases studies. The reasons for this choice were the successive reports of success of Brussels' public transport system, contrasting with the last years' tendency in Lisbon mobility. Besides that, Brussels has even been

referenced by Arthur D. Little (2014) as a useful role model for others cities, considered part of the group of smaller cities with good practices.

The analysis was divided in three main steps:

1. Observation and analysis of the urban mobility practises and measures that are being done in Brussels;
2. Observation and analysis of the urban mobility practises and measures that are being done in Lisbon;
3. Comparison of the two cities intermodal passenger transport systems, evaluating the best practises of each, the necessary points of improvement in Lisbon city and the potential application in Lisbon of some of the measures in place in Brussels, taking into account their specific circumstances.

In the study when mentioned Brussels it refers to Brussels-Capital Region and in the case of Lisbon is Lisbon municipally. For both cities it was considered every journey that has the city in study as a destination or departure and the internal journeys.

3.3.1 Data Gathering

Data about Lisbon and Brussels city were collect to contextualise them in terms of population, economic and mobility services. In order to do that it was consulted reports and websites of public transport operators and local authorities.

3.3.2 Author's Experience

The author's experience consisted on the use and observation of the different transports available to people in the both cities in analysis. In Brussels most data were collected in the months of April and May and in Lisbon during June and July.

It was analysed the passenger information available out board (stops and stations) and on board of vehicles (buses, trams, metro and trains), websites and mobile applications focusing mostly in intermodality.

Some of the author's journeys were registered, enhancing the relevant feeble points and main difficulties experienced, especially for non-frequent user (Annex VIII – Registration of Travels in the Public Transport of Brussels).

3.3.3 Surveys and Interviews

Two surveys were realized to understand the mobility behaviour, preferences and needs of the citizens of the two cities in analysis, Brussels and Lisbon. These surveys were aimed at evaluating the use patterns and perceptions of public transport users in both cities and also to understand if there are cultural differences in terms of urban mobility between the two cities. The

results of these surveys were also used to comprehend if some of the practices used in Brussels could also be used in Lisbon and if they could in fact contribute to the increase of public transport passengers or to encourage a modal split from private vehicle to a public transportation or soft mobility system.

Although the overall structure of the questionnaires used in Brussels and Lisbon were similar, they were adjusted to the different specificities of the cities, for example, language, economy, methods of payment, differences in transport operators and mobile applications available.

Both surveys were delivered online by using Google Forms and they were communicated using social network and electronic mail. In Table 3.1 there is more detailed information about surveys.

Table 3.1- Detailed information about surveys.

City	Brussels	Lisbon
Support	Online – Google Forms	Online – Google Forms
Language	French	Portuguese
Period (took place during)	May until July	June
Communication method	ULB Mobility page on Facebook On Facebook groups of ULB students To Friends through social networks	Friends and Family through social networks and by e-mail to students and personal of FCT-UNL.
Total groups	6	6
Total questions	36	38
Total answers (number of people)	51	445

The questionnaires were organized in six groups of questions:

- Group I (in Brussels survey this is the last group) – Personal Information: understand which is the relation between age, sex, occupation and monthly household income and the mobility choices.
- Group II – Mobility habits: comprehend the habits and the choices taken by the citizens in terms of mobility.
- Group III – Intermodality: questions related with transfers and correspondences between different transports modes.
- Group IV – Information Systems: understand the importance of information in public transport and the use of actual system.

- Group V – Tickets and Fares: importance of ticketing system to users and to facilitate intermodality.
- Group VI – Passengers' opinion: understand the relevance of the implementation of some new solution and how they would be accepted by passengers.

The goal was to have at least 100 answers to each survey, however in Brussels it was not possible. So, in order to supplement it, it was consulted the survey done by the department of mobility of *Université Libre de Bruxelles* (ULB) in December 2014 about the students' mobility (Ooghe et al., 2014).

The information acquired with surveys was used to complement the analysis about each city, to help comparing them and at last to develop and support the mobility strategies to Lisbon. Although a pre-test was done to six people, three in each city, before applying the surveys, not all the questions were used in the final analysis because some of the results proved not to be relevant to the study.

Both questionnaires are presented in annexes (Annex IV – Brussels Mobility Survey and Annex V – Lisbon Mobility Survey) as well as their complete results (Annex VI – Complete Brussels Mobility Survey Results and Annex VII – Complete Lisbon Mobility Survey Results).

Ten unstructured interviews were done to the frequent and non-frequent public transport users and to some of the operators' staff (Wilson, 2014), in order to acquire more detailed information and feedback from the passengers.

3.4 Proposing strategies to the city of Lisbon

The final part of this project consists of a set of strategic recommendations for passengers intermodality to the city of Lisbon. The author relied on the knowledge built when reviewing the literature and analysis of the good practices taken in other European cities and from the analysis of the case studies present in Section 4.

The aim of these strategies is to enhance passenger intermodality in the city and contribute to a more balanced modal split between private vehicle and other forms of transport.

In the process of strategies formulation some important points were considered:

- Integration of bicycle in public transport.
- Intermodal passenger information at real-time, especially about waiting times.
- Intermodal ticketing.
- Park and Ride systems.
- Integration of Lisbon mobility system with other systems at national and European level.
- The cost-benefit of the proposed measures.

4 CASE STUDIES – BRUSSELS AND LISBON URBAN MOBILITY

4.1 Brussels

4.1.1 Brussels Context

Brussels is the capital of Belgium and home to many international organisations. The Brussels-Capital Region (RBC) is one of the three regions of Belgium (Figure 4.1) and comprised of 19 divisions (Figure 4.2), with a surface area of 161.38 km^2 and a population of 1 163 486 inhabitants (2014), 10% of Belgium's population (11 099 554 inhabitants). The capital city has experienced a rise in population over the past few years, an increase of 16% in the past 10 years, and the tendency is to keep growing. The population number increases everyday with 329 thousand commuters (2013) entering in Brussels (BISA, 2014; BISA, 2015a).

The region of Brussels has a GDP of 71 745 millions € (2013), representing about 19% of Belgium total GDP (BISA, 2015b).

Figure 4.1 - The three regions of Belgium, with RBC in evidence (adapted from (Belgian Federal Government, 2015).

Figure 4.2 - The 19 divisions of RBC (CIRB, 2015a).

4.1.2 Brussels Transports

The Brussels Intercommunal Transport Company, known by the French acronym STIB, is the local public transport operator in Brussels. It is responsible for the metro, trams and buses, linking with the De Lijn network in Flanders and the TEC network in Wallonia. The National Railway Company of Belgium (SNCB) is the responsible for trains in all Belgium.

In terms of soft mobility, there is a bike sharing system named Villo! (Figure 4.3). This bike sharing system is linked and integrated with the local public transport,

Figure 4.3 – Villo! bike sharing system in Brussels (Edgar, 2014).

STIB. By using the MOBIB card[1] it is possible to access directly the bike sharing service, for 31 Euro per year. The first half an hour of each ride is free, after that period it charged a rent price (Villo!, 2015).

Similarly to Villo!, there is Blue-bike system, however this one is more focused on the train users and their correspondences (last-mile connection). For this reason it is only available in the main train stations in Belgium. To use it, it is necessary to have a Blue-bike card and in order to do that it is necessary to subscribe the service. With the card it is possible to rent two bikes. In contrast to Villo!, the Blue-bike has to be returned at the station of departure after using it (Blue-bike, 2015).

There are also other sharing systems, such as Cambio and Zen Car, both are car sharing systems with the difference that the fleet of Zen Car is composed by electric vehicles. The STIB is also a 50% shareholder of Cambio Company.

In Table 4.1 there is a summary of Brussels mobility operators with their network composition and other important information.

Table 4.1 - Mobility Operators in Brussels-Capital Region (source: 1 - STIB, 2015a; 2- Bruxelles Mobilité, 2015; 3- BISA, 2015c; 4- Blue-bike, 2015; 5- Bruxelles Mobilité, 2015; 6- Zen Car, 2015).

Operator	Network	Other information
STIB (1)	4 metro lines with 40 km 19 tram lines with 139 km 50 bus lines with 445 km 11 night bus lines	Major operator of public transport in Brussels Capital Region
SNCB (2)	28 stations in the RBC	The three main Brussels stations are Brussels South, Brussels Central and Brussels North
DE LIJN (2)	About 60 bus lines	Connecting Brussels region to some important regions of Flanders
TEC (2)	7 bus lines	Connecting Brussels to Brabant-Walloon and to Charleroi
Villo! (3)	331 stations 3965 bicycles 32811 subscribers (2013)	Brussels automated network bicycle rental. Network stations remote from each other by +/- 450 meters
Blue-bike (4)	4 Blue-bike points in Brussels (44 in Belgium)	Place near the main stations in Brussels (Brussels Central, Brussels North, Brussels South, and Brussels Luxembourg). The Blue-bike needs to be returned to the place where it was hired. The subscription cost 10€ per year. Local cost has a maximum of 3€ per 24 hours.
Cambio	133 stations 11535 subscribers (September 2014) (3)	A rent a car service by the hour, for the day or for longer periods, with a subscription system. Besides Brussels, this system is offered in 11 other cities in Belgium (5)
Zen Car		Electric car sharing system only available in Brussels (6)

[1] MOBIB card is the customer card used in Brussels public transport.

Moreover, there is a taxi service named "COLLECTO" where a person can share a taxi for a more economical price by sharing it with other passengers. This service works from 11 p.m. to 6 a.m., 7 days a week, the price of a journey is 5€ or 6€ per passenger (depending if the person is a MOBIB cardholders). The only drawbacks are that departures is just done at some STIB stops, with 200 departure points, and it is needed to call at least 20 minutes prior to the departure time to inform the operator of: the selected departure point; the exact address of the destination (within de Brussels-Capital Region) and to indicate the time when the person wishes to take the collective taxi (Bruxelles Mobilité, 2015).

4.1.3 What is Happening in Brussels?

In Brussels, in contrast to most European cities, public transport use recorded an increase of 52.4 % in the number of passengers in the last 10 years. Over the past 15 years STIB had an uninterrupted progression of attendance. This trend is expected to continue in the next 10 years, STIB needs to be able to accommodate 550 million passengers per year, an increase over 50% compared to 2014 (STIB, 2014).

In the last years, STIB acquired new vehicles in order to transport the growing number of travellers in the best conditions and offer them more travel options as it is expected that the number of passengers will keep growing. The renewed vehicles fleet were acquired having in consideration environmental concerns and passengers comfort (STIB, 2015b).

In 2014, Brussels invested in mobility and transport 837.1 million Euros, including construction and management of public transport networks 690.5 million Euros (BISA, 2014). Mobility to and within the RBC is a priority for the Government of the Brussels-Capital Region. The government has targeted a 20% reduction in road traffic by 2018. The intention is to encourage rational vehicle use and the main way to achieve this is by improving public transport services and promoting walking and cycling. Brussels-Capital Region has a plan to improve mobility by 2018 called Iris 2 mobility plan. Some of the priorities in the plan are to guarantee quality of life, to give everyone access to efficient and high-quality mobility infrastructure, to improve the complementarity of different modes of transport and introducing a parking policy. The plan provides for a raft of actions to improve the daily experience of commuters and tourists in Brussels by 2015-2018. Various projects, especially mobility-related infrastructure, have been initiated to improve public spaces in Brussels, including redeveloping squares and roads, reinforcing tunnels, renovating metro stations and introducing bike paths (CIRB, 2015b).

New cycling and pedestrian infrastructure, the extension of the Villo! network, the development of intermodal transport, from walking, cycling and skating to public transport (CIRB, 2015b), could be the reasons for the success in the continuing growing number of passengers in public transport.

4.1.4 Intermodal Passenger Systems

More than 50% of the respondents to the survey about urban mobility in Brussels answered that they use two or more transport modes to travel daily. Therefore, intermodality is without any doubt an important issue.

In Figure 4.4 it is a good example of an intermodal interchange. It is a metro and tram station, in the picture is visible there is only one-way for each transport (one-way for metro and other for tram). Upstairs there is the same lines but in the other direction. The aim is to ease the transfer to another transport mode. Besides that each stop as two sides in the platform, allowing getting in or out of the vehicles for the both sides what makes it easy and faster.

Figure 4.4 – Intermodal passenger interchange at *Gare du Midi*, Brussels (Nádia Pedroso, 2015).

Public transport and Bicycles

The use of bicycles in Brussels, in the last years, has increased, with a more significant impact after the introduction of Villo! bike sharing system (BISA, 2014; BISA, 2015).

The effort to integrate bicycles in public transport is visible all over Brussels and also in the connection of Brussels to the other cities. For example, as it is possible to observe in Figure 4.5, inside SNCB trains there is a designated area for bicycles and in front of it there are foldable seats for the bicycles owners. However, to bring the bicycle on the regional train it costs 5 Euro per trip or 8 Euro per day, in addition to the train ticket, for folding bikes it is free (SNCB, 2015).

Figure 4.5 - Old train of SNCB with place to bicycles on board (Nádia Pedroso, 2015).

At Brussels-North, Brussels-Central, Brussels-Luxembourg and Brussels-Midi stations there are some services available for bicycle riders, such as secure bicycle parking, bicycle rental and the possibility to make minor repairs (Bruxelles Mobilité, 2014a).

Bikes access to metro stations is permitted every day except during peak hours, from Monday to Friday from 7 a.m. to 9 a.m. and from 4 p.m. to 6:30 p.m., except for foldable bicycles. Stickers on the doors indicate where it is allowed to board. Carrying a bike is free (STIB, 2015c). In some metro vehicle there is a yellow pictogram with a bicycle indicating the designated area for bikes (Figure 4.6).

Figure 4.6 - Designated area for bicycles inside metro line 6 in Brussels (Nádia Pedroso, 2015).

Only in low floor trams (T2000, 3000 and 4000) bicycles are authorised at a rate of one bicycle (in T2000 trams) or two bicycles (in T3000-T4000 trams) per authorised access, according to the same rules as for the metro. In other models it is not possible due to the small doors of the vehicles and steps (Bruxelles Mobilité, 2014a; STIB, 2015d).

Cyclists passengers are authorized to use the escalators and some lifts available in some metro stations are accessible to bicycles (when the lift has sufficient size for bikes, there is a blue bike pictogram indicating) (STIB, 2015e).

There are also bicycle stairway/wheeling ramp in some stairs to make bike's access easy to metro and train stations (Figure 4.8 and Figure 4.7) (IBSR, 2007).

Figure 4.8 - Bike ramp in concrete, in Brussels (IBSR, 2007).

Figure 4.7 - Bike ramp in metal, in Brussels (IBSR, 2007).

Park and Ride

Parking is also important to urban mobility, by creating car parks in the outskirts of the city or bike parks all over the city it can help promote the intermodality.

Figure 4.9 - Car park in the outskirts of RBC (Bruxelles Mobilité, 2014b).

Currently, seven transit parking lots are available for cars on the outskirts of Brussels region. From these car parks, there are public transports to the city centre. Besides that, car parks are free (Figure 4.9) (Bruxelles Mobilité, 2014b).

Regarding bicycles parking, the city of Brussels opted for the inverted U-type. Several hundreds of them were installed, mainly in the city centre and in most metro stations. These sites are free and suitable for all types of cycling (Bruxelles Mobilité, 2014a). Brussels also has bicycle boxes on its territory for local residents. These boxes have key access and can accommodate 5 bikes from local residents. The rent for a place costs 60 Euro per year (City of Brussels, 2015).

At ULB there is a secure bicycle park available for students and personnel 24h/24h (ULB, 2015). That is one example of the efforts being done in Brussels to integrate bicycles in urban mobility (besides that there is also facilities at university available to take a shower).

4.1.5 Passenger Information Systems

In Brussels the efforts of regional authorities and transport operators to inform the passengers are evident. The information is available in different supports, out and on board of vehicles, and through internet or mobile applications. The focus in developing the real-time information to passengers is perceptible all over Brussels.

Out Board Information

As is possible to observe in Figure 4.10, there are information panels at some tram stops in Brussels that inform the passengers about correspondences. That is a very helpful information especially for a non-frequent passenger.

The information panels about correspondence with other transports were classified as Good by 37.3% of the respondents to the Brussels mobility survey. However, 31.4% have classified as Weak and 21.6% as Bad.

Figure 4.10 – Correspondence information panel in De Wand tram stop in Brussles (Nádia Pedroso, 2015).

In every bus or tram stop there is a sign informing the passengers about the transport mode (T for trams and B for buses), name of the stop, line number and destination. The stops with special services, such as night buses (called Noctis) and night shared taxis (COLLECTO) are also identified in the same stop sign as is visible in Figure 4.11.

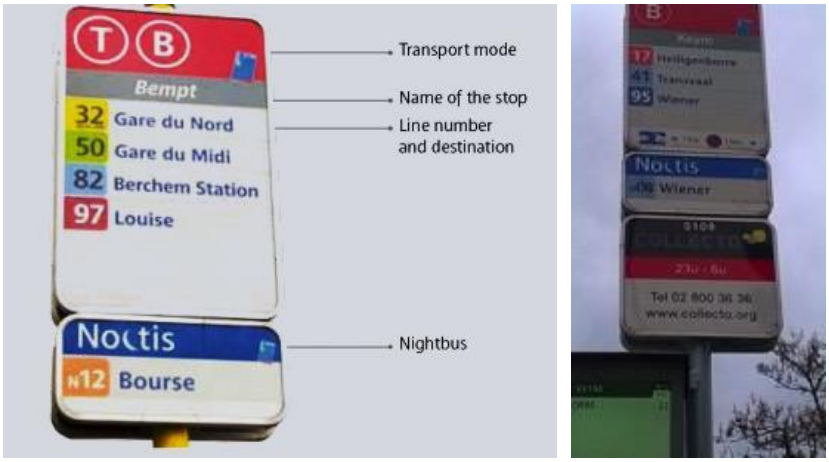

Figure 4.11 - Sign with different information at every bus and tram stop in Brussels (STIB, 2015f).

In some metro stations there is an information panel at surface where passengers are informed about the metro lines, the destination and the expected waiting time of the next metro (Figure 4.12).

Figure 4.12 - Surface metro information panel at De Brouckère with the metro number, destination and wainting time (Nádia Pedroso, 2015).

In almost every bus and tram stops there are real-time information displays, informing passengers of the waiting time of the next bus or tram. There are two different supports of real--time information as it is possible to observe in Figure 4.13 and Figure 4.14. In Figure 4.14 is the most recent system, which can also inform passengers of any disturbance in the network. Today, nearly 500 stops are equipped with these new displays (STIB, 2014).

Figure 4.13 - Bus stop at Gare Centrale, Brussels, with waiting time information (Nádia Pedroso, 2015).

In every tram and bus surface stop there is also timetable information about predicted time of bus or tram at that stop, as there is information about the public transport rules (Figure 4.14).

Figure 4.14 – Real-time display at Longchamp tram stop in Brussels, with a detailed photo of waiting time (Nádia Pedroso, 2015).

In all metro stations there are signs with detailed information about bus correspondences (Figure 4.15) and there are displays informing passengers about waiting time for next metro and its exact location in real-time (Figure 4.16).

The detailed information about the right exit of the metro station to a certain bus line stop is a very good solution that facilitates intermodality.

Figure 4.15 - Information sign at Gare Centrale metro station about correspondence with other public transport (bus and train) (Nádia Pedroso, 2015).

Figure 4.16 - Information panel at Gare Centrale metro station with the real time location of metro and waiting time (Nádia Pedroso, 2015).

Interactive screens are the most recent acquisition in information systems of STIB (Figure 4.17).

Figure 4.17 - Interactive screen at Gare Centrale metro station (Nádia Pedroso, 2015).

In the survey 52.9% respondent classified the real-time information provided by the public transport operators at stops or stations in Brussels as Good and 25.5% classified it as Very Good. The information panels about correspondences were even classified as Good with 37.3% of answers. That is a really good evaluation and it is a sign of the efficiency of the system.

On Board Information

In most Brussels buses and trams there is real time information on board (Figure 4.18). There is at least a two sides screen monitor in each bus, depending on the vehicle size, and more than one in trams. They inform about the bus or tram number and destination, time, previous, present and next stops, itinerary and also information about correspondence with other public transport modes, even if from a different operator (Figure 4.19 and Figure 4.20). The information about correspondence is detailed, it even have the exact number of the line in the case of STIB operator. In case of correspondence with metro and train it also has sound information.

Figure 4.18 - On board real time information systems at a tram in Brussels (Nádia Pedroso, 2015).

Figure 4.19 - Passengers Information on an screen inside a Bus (STIB, 2015b).

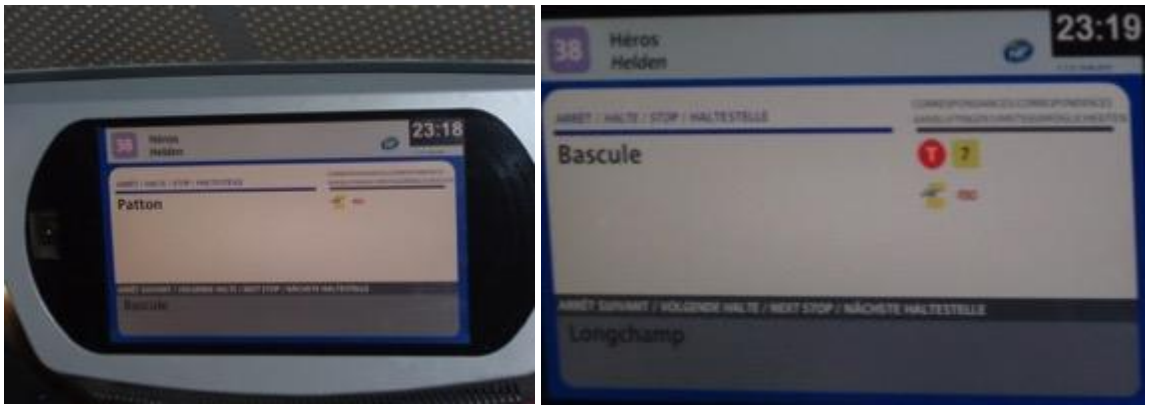

Figure 4.20 - Passengers information screen with correspondences at buses in Brussels (Nádia Pedroso, 2015).

In the few old of buses still operating, special during peak hours, the displays with information are not available. Nevertheless, it has the itinerary of the different bus lines where the bus operates.

Inside the metro the real-time information is audio and it also has a display screen informing the current station, next station and destination (in turns).

Above the doors there is information about metro network and also about correspondence with buses, trams and train stations, even for buses from different operators. The information about buses and trams is detailed, informing about the exact number of bus or tram line (Figure 4.21).

Figure 4.21 - Information metro lines and other public transport correspondences above the metro's doors (Nádia Pedroso, 2015).

On board of some trains (the most recent ones) there are monitor screens informing passengers. It informs about current and next stations, and predicted and real-time of arriving to next station. It also informs about correspondences with other trains, showing the destination and even the exact line to take it (Figure 4.22).

Figure 4.22 - SNCB information system with information about correspondences at a SNCB train (Nádia Pedroso, 2015).

As observed by the author, the real-time information on board of vehicles helps passengers when corresponding and make the experiencing of traveling more enjoyable. In the answers to the survey 47.1% of the respondents classified it as Good and 23.5% classified as Very Good. Also the audio information and the information about correspondences on board of vehicles were classified as Good, with 47.1% and 41.2% respectively.

Mobile and Website

The real-time mobile information is provided for free by STIB, available for iPhone and Android systems, in order to better inform their customers (Figure 4.23). STIB mobile is an application where is possible to consult the next departures in real-time, the actual location of the vehicles as well as the timetables. It also allows passengers to save regular stations and it has a localization function which enables passengers to find the nearest stop.

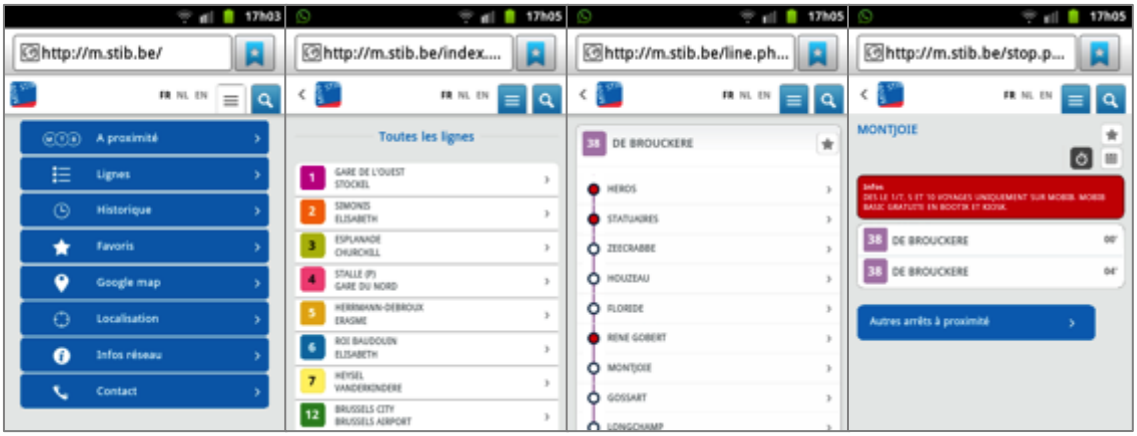

Figure 4.23 - STIB Mobile application from STIB operator (Nádia Pedroso, 2015).

As the author could experience, STIB mobile is very user-friendly, easy and fast to use, very intuitive, and it has a 92.3% of successful uses, as registered. In the survey, 47.1% of the respondents classified it as Good and 23.5% as Very Good.

STIB also has an information system called *Syncro*. This is a real-time information system, where a passenger sends an SMS to a specific number, pays 0.25 Euro per received SMS and in just a few seconds receives an SMS back with the waiting time the next two trams, buses and metros and in both directions (STIB, 2015g).

STIB also have all the information need in their website (www.stib.be), inclusive real-time information about their bus, tram and metro service (Figure 4.24). They are also in the social networks, such as Facebook and Twitter, in order to keep their customers updated of any news or last minute changes/problems or any questions/doubts the users may have.

Figure 4.24 – STIB website infomation to the passengers
(Nádia Pedroso, 2015).

The website of *Bruxelles Mobilité* (http://www.bruxellesmobilite.irisnet.be/) has real-time information about all important aspects of mobility in Brussels: public transports, bike sharing, car sharing, car parks, free-moving traffic, jams, roadworks that can cause inconvenience (Figure 4.25).

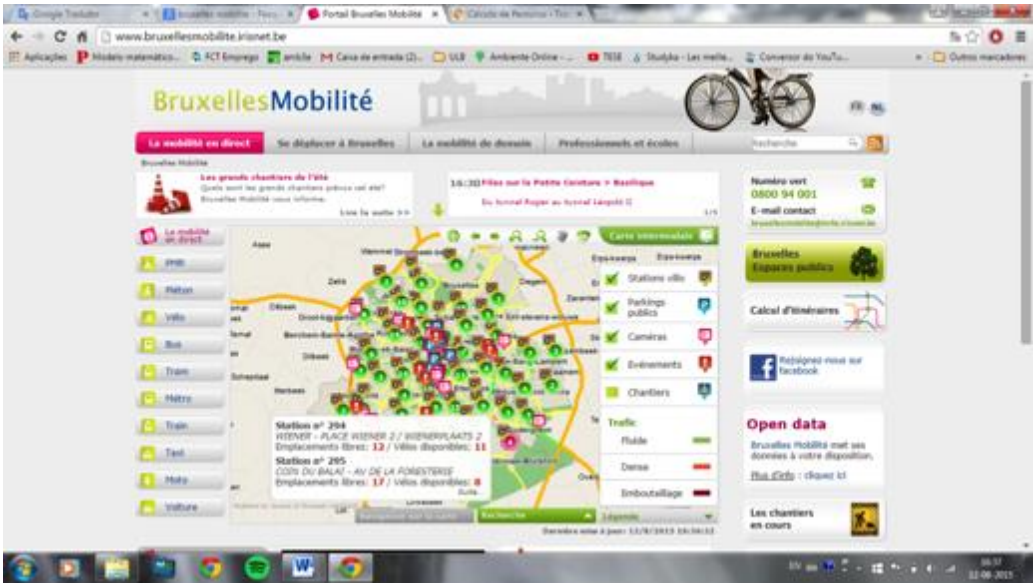

Figure 4.25 - BruxellesMobilité website (Nádia Pedroso, 2015).

The other transport operators, as for example Villo!, have their own site and mobile application that gives real-time information what helps passengers and could contribute to a better switch of transport mode.

The information provided on the websites about timetables and itinerary were classified as Good, for 51% and 49% of the respondents respectively.

The only information classified as weak by the survey respondents was the information in case of service disruption, with 41.2% answers.

4.1.6 Ticketing Systems

There are three different support tickets in Brussels. In Table 4.2 is more detailed information about the tickets support.

Table 4.2 - Tickets support in Brussels (adapted from STIB, 2015b).

	MOBIB card	MOBIB basic card	Paper Ticket
Card photo			
Use	MOBIB card is nominative, so cannot be shared. It is possible to load until 8 different public transport titles in one card, inclusive season ticket (month or annual).	Anonymous card and can be shared. Cannot be load with season ticket. It is possible to load until 8 different public transport titles in one card. Can only be load it with e.g. 1,5 or 10 journeys, and 24h, 48h or 72h tickets.	Paper ticket with magnetic strip. Only available to 1 journey, 1 day and Airport Line tickets.
Price	5 €		-
Duration	5 years		-

In the present year (2015) some changes were done in the ticketing system in Brussels. Since 21st of April, the MOBIB card becomes interoperable. Since then, the titles of 1, 5, 10 voyages, round-trip, etc. are available on MOBIB card and can be used with all transport operators in Brussels (STIB, SNCB, TEC and De Lijn). To travel in the Airport area with a MOBIB card and MOBIB Basic card, only titles of 24h, 48h, 72h and to Airport Line are valid. To travel with the different operators, the passengers simply have to validate their ticket depending on the rules applicable to the various operators.

After the 1st July, the STIB paper tickets are only available on titles of one journey and 24h, all other modes of titles are only available in MOBIB card or MOBIB basic card. The goal is to eradicate in a near future (2016) the paper tickets and replaced by smart contactless tickets (STIB, 2015b).

In Table 4.3 are present the ticket available in RBC. Other tickets besides the ones on that table are also available in combination with other transport mode.

Table 4.3 - Tickets available in RBC (adapted from STIB, 2015b).

Tickets	Description	Cost
1, 5 or 10 Journey(s)	Valid for one, five or ten journeys with connection to the entire STIB network and to the Brussels DE LIJN, TEC and the SNCB urban networks.	1: 2.10 € / 2.50 € (onboard) 5: 8 € 10: 14 €
Round-Trip	Valid for 2 journeys with connection to the entire STIB network and to the Brussels DE LIJN, TEC and the SNCB urban networks. 2nd journey must be done until maximum 24h after 1st validation	4.20 €
24h/48h/72h Ticket	Unlimited access on the entire STIB network (inclusive airport line) for 24h, 48h or 72h and on the Brussels DE LIJN, TEC and SNCB urban networks.	24h: 7.50 € 48h: 14.00 € 72h: 18.00 €
STIB Season Ticket	This pass offers you unlimited access for 1 month or 1 year on the entire STIB network (except airport line).	49 € (month) 499 € (year)
MTB Season ticket	Valid on the STIB network (except airport line), urban networks of TEC and DE LIJN in the RBC and in the 2nd class, railways SNCB in the Region Brussels for 1 month or 1 year.	55.50 € (month) 583 € (year)

In Brussels, most of the tram and bus stops have a Go Ticket self-service machine where is possible to buy a ticket or recharge the season ticket (Figure 4.26). Besides the fact that it is less expensive than buying a ticket on board, it also avoids wasting time buying the ticket to the driver, which may cause possible delays.

Figure 4.26 - Go Ticket self-service machine in Brussels (James O, 2013).

Ticketing corresponding airplane and train

As observed by the author, at Brussels airport is possible to buy the tickets to the train while passengers are waiting for their luggage to arrive (Figure 4.27). Besides that, as it is possible to see in the Figure 4.27, over the ticketing machine it is also possible to see the trains timetable.

This type of solutions encourages the use of public transport, by making passengers use the time wasted waiting for their baggage to buy the train tickets, avoiding more time wasted in the train station and avoiding them to lose the earliest train.

Figure 4.27 - Train tickets machine at baggage claim at Brussels airport (Nádia Pedroso, 2015).

4.2 Lisbon

4.2.1 Lisbon Context

Lisbon is the capital city of Portugal and the centre of a metropolitan region with 3,015 km², which is 3.3% of the total area of Portugal (Figure 4.28). 26.7% of the total population of the country lives in Lisbon Metropolitan Area (AML), the largest population concentration in Portugal (AML, 2015; CML, 2014).

The AML is an administrative division that includes 18 municipalities, with 2.8 million inhabitants (2011), of which 548 thousand (19.4%) lives in the city of Lisbon (with 84.9 km² of superficial area and 24 parishes) (AML, 2015; CML, 2014). The municipalities in the north of the Tagus River are from Lisbon District (*Grande Lisboa*), those in the south of the river are from Setubal District (*Península de Setúbal*) (Figure 4.29).

The number of the city users rises daily 40.9% (from its 548 thousand residents to 925 thousand persons), due to the commuting movements. Lisbon registered the stabilization of its population, after 5 decades of population decrease (CML, 2014).

Figure 4.28 - Portugal with Lisbon Region in evidence (adapted from Turismo de Portugal, 2013).

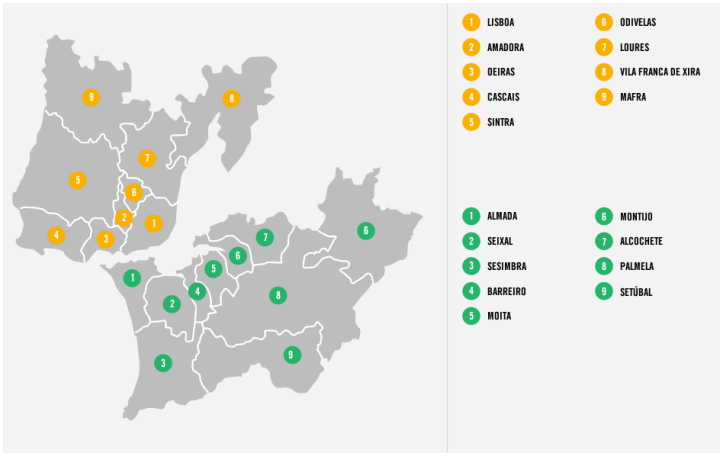

Figure 4.29 - Lisbon Metropolitan Area divided into the 18 municipalities (in yellow: Lisbon District and in green: Setubal District) (INÂMIA-CET/ISCTE-IUL, 2011).

The majority of the national economic decision centres are located in the Lisbon region. With over than 30% of the national employment being located in its territory, the contribution of AML to the national GDP represents 37% (CML, 2014).

Last but not least, Lisbon is the destination of more than 4 million tourists per year, half of them originated from foreign markets (CML, 2014).

4.2.2 Lisbon Transports

The two main operators in Lisbon are Carris and Lisbon Metro (*Metropolitano de Lisboa-ML*). Recently, these two operators and Transtejo Group launched the Lisbon Transport brand. The aims are to transmit the concept of integration of the three modes of transport as well as the improvement of intermodal objectives and service optimization provided to thousands of customers (Carris, 2015).

Carris is the main operator of buses, trams, lifts and funiculars in Lisbon, transporting around 300 million of passengers per year (Carris, n.d.-a). The underground is of the responsible of Lisbon Metropolitan, ships and ferries are of Transtejo Group and the main trains operator is Trains of Portugal, most known for the portuguese acronym CP (*Comboios de Portugal)*. Besides these four operators, there are other operator in Lisbon city and AML, listed in Table 4.4 below.

Table 4.4 – Transport Operators in Lisbon region (source: 1- ML, 2012; 2- Carris, n.d.-a; 3- Rodoviária de Lisboa, 2010; 4 - TST, 2015; 5- CP, n.d.-a; 6- Transtejo, 2015a).

Mode of transport	Operator	Network	Other information
Metro	*Metropolitano de Lisboa (ML) (1)*	4 metro lines, 43 km	Public company
	Metro Sul do Tejo (MST)	Not in Lisbon region (part of AML)	Private company
Bus, Tram, Funicular and Lift.	Carris (2)	78 bus lines, 667 km 6 night bus lines 5 tram lines, 48 km 1 lift 3 funiculars	Public company
	Rodoviária de Lisboa (3)	1300 km of network 94 bus lines 2100 stops in all network	Serves Lisbon, Loures, Odivelas and Vila Franca de Xira cities. Private company
	Scotturb	Not in Lisbon region (part of AML)	Private company
	Sulfertagus	Not in Lisbon region (part of AML)	Bus service, complementing Fertagus trains in the south bank of Tagus River.
	Transporte Sul do Tejo (TST) (4)	Bus service (Private company), mainly in north of Setubal District	Connect Lisbon with the south bank of Tagus River (part of AML).
	Vimeca Transportes	Bus service with some stops in Lisbon city (Private company)	Connect Lisbon to the municipalities around.
Train	*Comboios de Portugal (CP)* (5)	15 stations in Lisbon Region (Public company)	Also to connect Lisbon to the municipalities around and other cities in Portugal.
	Fertagus	4 stations in Lisbon region (Private company)	Connecting Lisbon with the south bank of Tagus River (part of AML).
Boat and Ferry	Transtejo/ Softlusa (TT/SL) (6)	3 stations in Lisbon region (Public company)	Connecting the two banks of Tagus River.
	Atlantic Ferries	Not in Lisbon region (part of AML)	Public company
Car sharing	Mob Carsharing	Suspended since 21st June of 2015	
	Citydrive	More flexible service, one-way model (Private company)	Started in 2013

The first car sharing system appearing in Lisbon was Mob Carsharing. However, since 21st June of the present year (2015) the service was suspended after 7 years of working (Mob Carsharing, 2015). In 2013, a new car sharing service was launched, the Citydrive. This new service provides a one-way car rental model paid by the minute. It brought a novelty to the market: the one-way

model. For the first time in Portugal the user does not need to return the car to the starting point (Citydrive, 2015).

4.2.3 What is Happening in Lisbon?

In Lisbon the number of passengers in public transport has been decreasing in the last decade, like some other countries in Europe (INE, 2015). However, since mid-2014 some signs of reversal of the negative trend in the demand behaviour have started to be observed (ML, 2015a).

In the study "Future of Urban Mobility" of Arthur D. Little (2014), which intended to assessed the mobility maturity and performance of 84 cities worldwide (covering seven geographical regions across all continents) using a Urban Mobility Index, Lisbon was below the average score of the analysed European cities, being one of the worst cities in the sample (together with Athens and Rome). By saying this, made clear the need of improvements in the Lisbon's transports.

In terms of bike sharing, Lisbon is following the example of other European capitals and cities all over the world. The city intends to implement in a near future a bike sharing system to complement the public transport (CML, 2015).

In the city of Lisbon, there is an ongoing program to reduce the volume of traffic. As mentioned by CML (2015), the combined use of public transport and bicycles can play a key role in pursuing this objective.

4.2.4 Intermodal Passenger Systems

In Lisbon in the last couple of years in has been notable some effort to have a better intermodal passenger system. More than 40% of the survey respondents use two or more transport modes and 50.8% classified infrastructures (transports interchanges, integration of bicycle in public transport and parks) as a Very Important criterion. Therefore, intermodality is very relevant issue that should be taken into consideration when the aim is to improve urban mobility.

Public transport and Bicycles

Carris and Bicycles

In Carris there is a Bike Bus service (Figure 4.30), this was launched in September 2007, only operating with 2 bus lines at weekends and holidays. Later the service was extended, currently has 5 bus lines (Table 4.5), working 7 days a week (Carris, n.d.-b).

Figure 4.30 - Bicycles on Carris Bike Bus (Carris, 2012).

Table 4.5 -Bike Bus lines of Carris in Lisbon (Carris, n.d.-b).

Bus line	Bus Stop	Bus Stop
708	Martim Moniz	Parque das Nações
723	Campo Mártires da Pátria	Algés
724	Alcântara	Pontinha
725	Estação do Oriente	Prior Velho
731	Av. José Malhoa	Moscavide Centro

Lisbon Metropolitan and Bicycles

In Lisbon's metro bicycles are authorized, free of charges, throughout the period of operation of the service (6:30 a.m. to 1:00 a.m., Monday to Sunday). However, the operator advised to avoid bike transport at peak times on week days. Bicycle transport in metro can be realized within a maximum of two bicycles per carriage, provided that there are no large passenger agglomerations and if the normal system operation is not disturbed (ML, 2013a). Nevertheless, besides these policies, transporting bicycles on escalators, conveyors and lifts in existing stations and access is prohibited and no other solutions are presented. The bicycles access to metro stations is not easy, there are a lot of stairs and no adaptations to bicycles.

CP, Fertagus and Bicycles

Bicycles are allowed in both train operators in Lisbon, in carriages identified for that purpose in all urban trains (Figure 4.31) and it is free every day and at all times. In Fertagus operator, in each designated carriage up to two bicycles may only be transported. In the case of CP

Figure 4.31 - Pictogram indicating the bicycle carriage in Fertagus (in the left) and CP (in the right) (Nádia Pedroso, 2015).

trains is not explicit if there is a maximum number to bicycles allowed in carriages and in some trains the space for bicycles are not well adapted for that purpose (Figure 4.32).

Figure 4.32 - Designated area for bicycles on a CP train (Nádia Pedroso, 2015).

Furthermore, as verified by the author, the train entrances for bicycles, even from the same operator, do not always stop in the same place of the platform. This varies depending on the train line, train model and period of the day. As a consequence, cyclists do not know exactly where to board their bicycles. This situation can be an inconvenient for them and it may also contribute to some delays.

The use of escalators and lifts in existing stations are forbidden for bicycles (Fertagus, 2015). In spite of all the practises that have been being implemented, the accessibility to cyclists is not good or even inexistent (Figure 4.33). There is no adapted accesses to bicycles, it is not explicit at the escalators if bicycles are allowed to use it or not and the existing lifts have no space.

Figure 4.33 - Stairs access to train platform at Entrecampos station (Nádia Pedroso, 2015).

Transtejo and Bicycles

Bicycle transport is free in all fluvial connections. The maximum capacity of bicycles vary between 4 or 6 bicycles in work days within the peak hours (6:30 a.m. to 9:30 a.m. going from south to north and 5:00 p.m. to 8:00 p.m. going north to south) to 8, 10, 12 or 15 bicycles in work days off-peak hours, weekends and holidays and with an occupancy rate below 50% of maximum ship capacity (Transtejo, 2015b).

The access of passengers to boats is done by a ramp which also allows the easy access by cyclists.

Park and Ride

According to CP (n.d.-b), passengers can leave their bicycle in one of the parking lots for bikes at the stations of Sintra, Cascais and Azambuja lines. Also, at the entrance of Fertagus stations (except in Roma-Areeiro) there are bike racks where passengers can park their bicycle (Fertagus, 2015).

In Lisbon, there are forty new parking areas with capacity for more than 300 bicycles in secured and strategic locations in the city (markets, cultural venues, shopping, public transport interchanges and urban parks), according to Lisbon City Council (CML, 2015).

Regarding car parks, there are car parking lots inside the city that could even be combined with the season ticket/pass.

In the outskirt of the city there are few car parks and the conditions are not the best ones (e.g. not secured, poor light, not enough space). However, in the south bank of the Tagus River (District of Setubal), the railway company Fertagus provides car parks at their stations, which is a good intermodal solution. This enables the correspondence with the train to Lisbon, avoiding people taking their cars to the city.

4.2.5 Passenger Information Systems

In Lisbon there are different mechanisms to inform passengers, provided by transport operators or private initiatives. For example, the bus operator Carris offers different mechanisms of real-time information. The system used is a real-time operation based on accurate knowledge of the position of each vehicle (via GPS) which, when transmitted to the Traffic Control Centre, allows to transmit reliable data and at real-time to passengers (Carris, n.d.-c).

In the survey, about 70% of the respondents classified the information available as Very Important criteria, which demonstrates the significance of passengers' information systems to urban mobility.

Out Board Information

In every Carris bus and tram stops there is a sign informing about the number of bus or tram line (Figure 4.34), a plan of the main public transport network (Carris, ML, CP and TT) in Lisbon and timetables and itinerary of the different buses or tams lines passing at that stop (Figure 4.35).

Figure 4.34 - At a bus stop (Nádia Pedroso, 2015).

Figure 4.35 - Information bus stop in Lisbon (Nádia Pedroso, 2015).

In April 2001, Carris began the process of implementing electronic panels at bus stops, with information on the expected arrival time of vehicles, allowing the customer to manage his/her own waiting time at stops. This is an ongoing process of the company, which currently has 350 installed panels (Carris, n.d.-c). In Figure 4.36, it is an example of a Carris real-time display in one bus stop in Lisbon city.

Figure 4.36 – Real-time information display in a bus top in Lisbor (Nádia Pedroso, 2015).

In metro stations platforms there is information about waiting time for the next vehicle presented in screen displays like the one in Figure 4.37. Also in the platform and/or near the metro's entrance there is a plan of metro and train network. However, a plan of bus and tram network does not exist. Besides that there are information panels about correspondence with train stations (Figure 4.38) and with bus stations, usually for correspondence with suburban buses. Nonetheless, in most of the stations the information about the location of urban bus stops is not very visible and not very clear (Figure 4.39).

Figure 4.37 - Display with waiting time in Lisbon metro (Nádia Pedroso, 2015).

Figure 4.38 - Information sign about metro correspondence with train (Nádia Pedroso, 2015).

Figure 4.39 - Map with information about bus correspondences at some metro stations (Nádia Pedroso, 2015).

In train platforms and station there are signs informing passenger about correspondences with metro and buses. Nevertheless, the information about the metro or bus lines is not detailed (Figure 4.40 and Figure 4.41). There is no information about the bus number or about metro line.

Moreover, in Entrecampos train station was noticed the lack of information about correspondence with taxis.

Figure 4.40 – Information panel at Entrecampos train platform (Nádia Pedroso, 2015).

Figure 4.41 – Information panel at Entrecampos train station (Nádia Pedroso, 2015).

In the survey to the city users, more than 40% classified the information about timetables and itineraries at stops and stations as Good and more than 30% as Weak. When questioned about the real-time information 34.8% classified as Weak.

Interactive screens are the most recent acquisition in terms of information system in Lisbon (Figure 4.42), it is available in some stations.

Figure 4.42 - Interactive screen at Sete-Rios metro station in Lisbon (Nádia Pedroso, 2015).

On Board Information

In the Lisbon metro, there is, inside every vehicle, over the doors, the plan of metro network, informing about train and boat correspondences and main bus stations (suburban and national bus lines) (Figure 4.43).

There is also a display informing about next station and destination and audio information notifying about stations, destination and correspondences with railway stations. In trains is similar to metro.

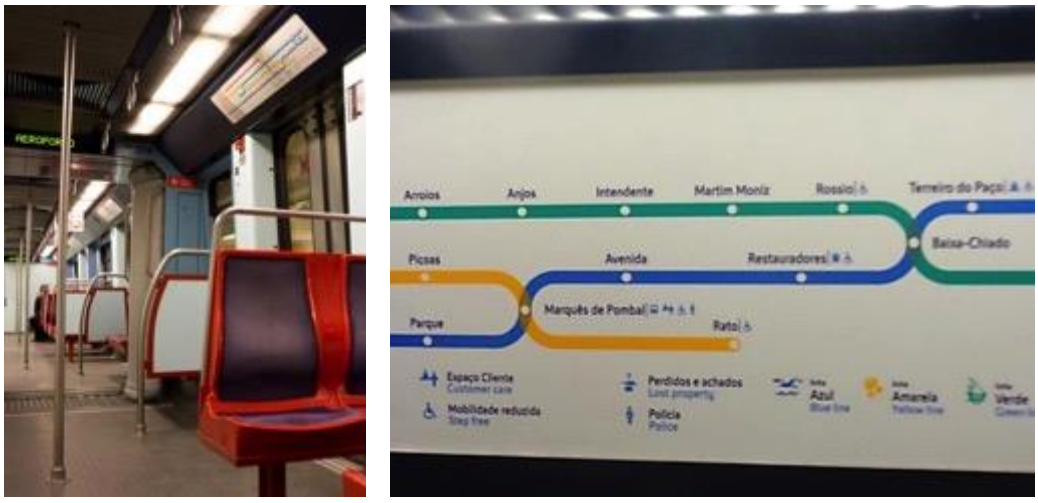

Figure 4.43 - Information onboard of metro in Lisbon (Nádia Pedroso, 2015).

The more recent trams inform via audio the next stop. Inside most of the bus fleet there is not any type of information about stops, itinerary or correspondences.

In the survey 36.2% of the respondents classified the information on board about correspondences with other transport modes as Weak and 42.5% considered the information about next stop or station as Good.

Mobile and Website

In Lisbon only metro operator has its own mobile application. To the other operators there are a lot of different mobile applications available. In Table 4.6 are summarized the functions of some of mobile apps available in Lisbon, as also the weak points detected by the author, after analysing and use it.

In general, the mobile applications are not very advertised near passengers and by consequence not very known by general public as it was clearly by the answers to the survey. When questioned about the knowledge of *Move-Me* app, 85.1% of respondents answered that they did not know the application and 9% answer it was Good. Even the Metro app is not easy to find information about it or know about its existence in the operator's website.

Although Carris does not have its own application, it supports the development of some apps, with the transfer of data, to support the public transport customers in the city of Lisbon.

Table 4.6 - Mobile applications available in Lisbon (Adapted from Carris, n.d.-c).

Application's name	Functions	Weak points
Move-Me	It allows consulting operators' information and plan a route in real time with correspondences between different operators. Reports on arrival and departure times of vehicles. The map function allows in a given location know about: - Closest stops - Points of interest nearby - Next vehicle to pass at stop	It does not refresh the waiting time automatically, it is need to keep refreshing, otherwise the time is not correct.
IZI Carris	Informs about the time remaining to arrive the next Carris vehicle to the stop. Save favourites bus stops or lines	The service fails often. Take time to load the information. Only works with Carris.
Sapo Transportes	Informs about the possible routes to any point (origin/destination) of AML. Allows to: - check the timetables of different career lines, organized by mode of transport. - see the routes and the stops of the various public transports. - save favourites.	Information is not in real-time. It is based on the timetables of each operator, which does not always correspond with the real-time, so it is not really useful.
Metro LX	Inform about the lines status in real time, closest stations and points of interest nearby. Information on Metro network map, schedules and fares. Inform about the latest news and allow to receive alerts via Push Notifications.	Does not have real-time information about the waiting time of next vehicle. Only works with Metro.

In the last months some mobile applications have been emerging with better information available and more user-friendly design, nevertheless the real-time information and the information about correspondences between the different transport modes still need an upgrading.

Moreover, Carris has an SMS messaging information system that gives real-time information about waiting time for all vehicles or of the next three vehicles of a bus line at particular stop. This service has the same costs as a standard SMS message. Carris also has an email service providing information on actual time of passing vehicles at stops.

Regarding websites there are also a few. One example of a website with intermodal information is Transporlis. This website inform about different itineraries and timetables of public transport from the different operator in Lisbon (Figure 4.44). Although it does not have the information of waiting times in real time, it gathers useful information and it is a good sign to intermodal information. In the survey done 76% of the respondents did not even know about the existence of it, however the major part that knew (14.7%) considered it as Good.

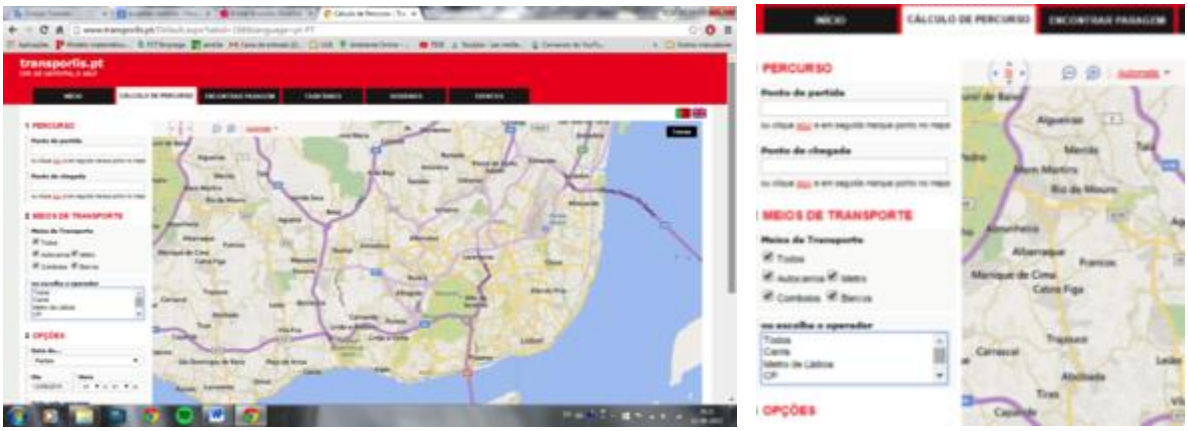

Figure 4.44 - Transporlis Website (http://www.transporlis.pt/).

Each public transport operator have their own website, however there is a recent website (http://www.transporteslisboa.pt/), that join the main public transport operators (Carris, ML and TT) redirecting to their own website after. None of these websites have real-time information about next departures.

There is also another website called Portal Viva (https://www.portalviva.pt) mainly about public transport ticket support cards and fares.

More than 50% of the survey respondents classified the information (timetables and itineraries) provided by Lisbon public transport operators in websites as Good.

Airport and Public transport

In Lisbon airport, there are interactive machines of Transporlis at the baggage claim with information about Lisbon transports. Also there are signs informing about the localisation of metro station and taxis.

4.2.6 Ticketing Systems

In Lisbon, there are three different types of support cards for transport titles: *Lisboa Viva*, *Viva Viagem* and *7 Colinas*. In Table 4.7 is presented more information about these supports cards.

Table 4.7 - Tickets support cards in Lisbon (adapted from OTLIS, 2015).

Cards	*Viva Viagem* and *7 Colinas*	*Lisboa Viva*
Photo		
Use	They have exactly the same functions and the same type of use, differing only in name and image. Created for the less frequent customers. Only allows the loading of a single type of ticket at a time. Do not support season tickets (Passes).	Card for loading passes or other transport titles, accepted by all transport operators in the Lisbon Region. Carries the load up to 4 different transport tickets.
Price	0,50 €	Normal (delivered in 10 work days): 7,00€ or 3,50€ for 4_18/sub23 mode [2] Urgent (1 work day): 12,00€ or 6,00€ 4_18/sub23 mode
Duration	1 year	4 to 6 years

Beside the support cards presented in Table 4.7 there is *Caixa Viva* card, it is a debit card which also includes an application for transport. It is requested by the client at *Caixa Geral de Depósitos* bank and serves as debit/ATM and also as regular card that gives access to transport of participating operators.

In Table 4.8 is presented the information about fares and tickets practiced by the main operators in Lisbon.

[2] 4_18 and Sub23 are pass cards with discounts. Customers with a 4_18@escola.tp card who are beneficiaries of the Social Education Allowance or students from families eligible/beneficiary of the Social+ Pass and students with a sub23@superior.tp card from families eligible/beneficiary of the Social+ Pass (Carris, n.d.-d).

Table 4.8 - Tickets available in Lisbon (adapted from OTLIS, 2015 and Carris,n.d.-d)

Tickets		Description	Cost
Non-frequent tickets	**Single ticket Carris/ML**	Valid for one journey in the Carris/ML whole network, during 1 hour after the first validation	1.40€
	1 Day ticket Carris/ML	Valid in Carris/ML network for 24 hours after the first validation	6€
	On board Ticket	Bus	1.80€
		Tram	2.85€
		Bica, Glória and Lavra Funiculars (up to 2 journeys)	3.60€
		Sta. Justa Lift (up to 2 journeys)	5€
	Zapping - 1 journey Carris, ML, TT/SL and CP	Loaded with money Valid for one journey during 1 hour after the first validation (can be continuously used until it has money charged)	1.25€**
Season Tickets/ Passes	**Carris, Metro and CP* month Pass**	Intermodal passes, network or just urban zone. Possibility of combined passes with other operators in AML.	35.65€

*CP - just in Lisbon city Zone 1"Coroa L" , outside more expensive
** TT/SL and CP outside Zone 1 "Coroa L" different prices
Note: None of these tickets is valid in the tourist circuits neither in Airport buses

Only in metro stations there are machines to buy tickets to Carris or ML or to charge season tickets. So, when a passenger takes a bus or tram in a stop where there is no metro station, most of the times the passenger has to buy a ticket on board. The on board ticket of Carris is like a receipt (a small paper) and it is not possible to change to other bus, tram or metro with it, the passenger have to buy another ticket, what does not favour intermodality.

The problem is that in many bus stops is not possible to buy a ticket or recharge it on a ticket machine or with an operator in the ticket office. Besides that, it is a disadvantage for the operator because the vehicle must be stopped so that the driver can sell the ticket to the passenger.

Carris does have a system called "Ponto Mob Carris" where customers can buy tickets or recharge them in some shops all over Lisbon. The main disadvantage is that it depends of the schedule of the shop, so it is not available during the entire Carris's operating period.

Another observed problem when using different modes of transport was for example: in a single journey from Lisbon to *Monte* da Caparica (in the south bank of the Tagus River), if a passenger needs to take a bus or metro in Lisbon to get to a train station, then take the train and, when arrives to the other side of the river (at Pragal station), take the metro, it is necessary three different tickets in three different support cards. This may discourage the use of public transport and it is definitely not a good practise of intermodality.

In the survey done 72.8% of respondents referred the intermodal fare as a Very Important criterion. Therefore, it is an issue that must be taken into consideration when promoting intermodality.

Airport and Public transport

In the airport, to buy a bus ticket it is necessary to go to the metro station and buy at the metro's machine ticket or at a metro's ticket office or otherwise buy a ticket on board of the bus. There is also a touristic card that includes some entrance in museums or discounts and travel pass from some days. This one is possible to buy at the airport. However, it is more expensive that a one day ticket bought at a public transport operator.

4.3 Comparing Brussels and Lisbon

While comparing two different mobility systems of two different cities from two different countries, it is necessary to be careful and to be aware of the social, cultural and economic differences, besides the topography and other relevant geographical differences. Therefore, the first analysis done is to understand the current tendencies and the mobility habits of each city. Further, the users preferences' and the evaluation of the transport services in each city are discussed using the data collected in the surveys, complemented with other sources.

4.3.1 Population and Public transport

In order to have an overview about the current population and public transport networks of each city a summary of the data is presented in Table 4.9. In the table is observable a difference in the number of inhabitants. Brussels has more than twice the population of Lisbon, however as the area is also larger, the cities are similar in terms of population density. Concerning the public transport networks, it is bigger in Lisbon, a justification for that can be the fact of the bus and metro networks of the main operators in Lisbon go a little beyond the boundaries of Lisbon municipally. In general, the two cities do not present significant differences, being suitable for a comparison.

Table 4.9 -Summary of population and public transport network service of Brussels and Lisbon (data cited in sections 4.1.1 and 2 4.2.1 and 2).

	Brussels	Lisbon
Population (nº inh)	1 163 486	547 733
Commuters (nº inh)	329 000	377 267
Number of city users (population plus commuters)	1 492 486	925 000
Area (km^2)	161	85
Population density (inh/km^2)	7 210	6 452
Bus network (km)*	445	667
Tram network (km)*	139	48
Metro network (km)*	40	43
Total Bus, Tram and Metro network (km)*	624	758

*only considering the main operator

Further, it was assessed the development of each city, where data about population and number of public transport trips was utilized. In Figure 4.45 is visible the evolution of population and public transport in the last years in Brussels and Lisbon.

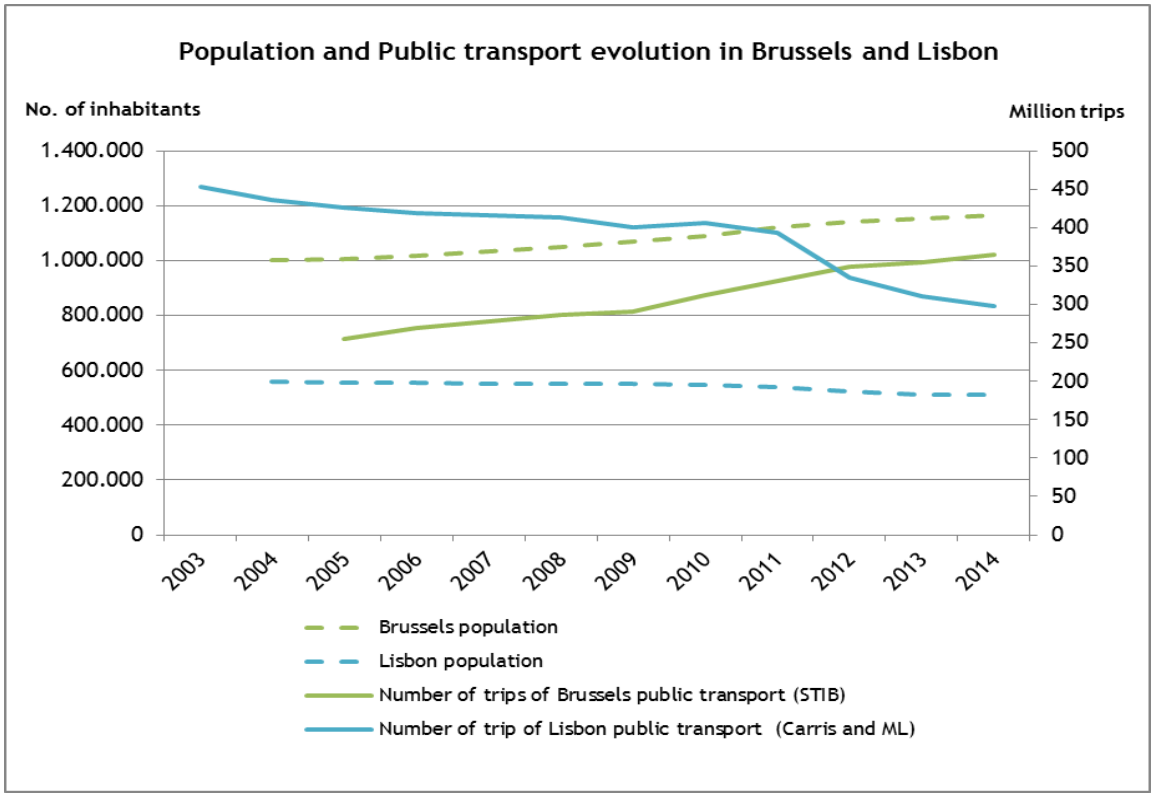

Figure 4.45 - Population and Public transport evolution in Brussels and Lisbon (adapted from BISA, 2015a; Carris, 2007; Carris, 2009; Carris, 2013; Carris, 2014a; INE, 2015; ML, 2005; ML, 2009; ML, 2013b; ML, 2015b; STIB, 2014).

The analysis shows that both cities have contrasting tendencies. While in Brussels the trend is the growing of population and the increasing of public transports trips, in Lisbon the two variables are decreasing. In order to understand if somehow the fact that population are increasing or decreasing influenced the number of trips, the author compared the population growth rate and public transport growth rate (bus, tram and metro) from both cities. As shown in Table 4.10, the decreasing population in the city of Lisbon it does not have a direct influenced in the decrease of frequency of public transport and the same happens in the case of Brussels. In that context, it is exclude the possibility of the reason for the increase or decrease in the use of public transport being related to the variation of cities population.

Table 4.10 - Population and Public transport growth rates (Nádia Pedroso, 2015).

	Period (9 years)	Growth rate	%
Brussels	2005 to 2014	**Population**	15,6
		STIB	43,1
Lisbon	2005 to 2014	**Population**	-8,4
		Carris + ML	-30,2

4.3.2 Mobility Habits

In both countries more that 60% of the respondents that uses public transport uses it when commuting, but in Brussels this percentage is about 10% higher than in Lisbon (Figure 4.46). Also in terms of the soft modes, like walking and cycling, the percentage of using them are higher in Brussels as is possible so see in Figure 4.47.

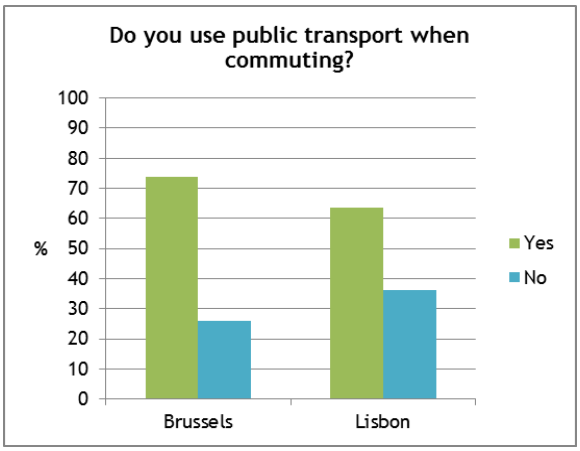

Figure 4.46 - Use of public transport when commuting in Brussels and Lisbon (Surveys resuslts).

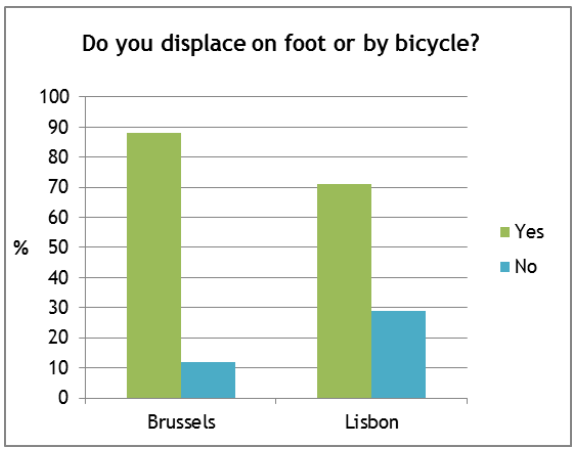

Figure 4.47 - Use of soft modes in Brussels and Lisbon (Surveys results).

The knowledge of reasons why people use public transport when commuting is important to comprehend what motivates them and then to enhance those factors to attract more users. The results of the survey demonstrated that in Brussels the main reason for using public transport to commute is because it is “More practical”, immediately followed by “Environmental reasons”, while in Lisbon the majority of respondents (42%) mentioned “Economic reasons” as the main motivation (Table 4.11). Those results are possibly a sign of different mobility cultures, in Brussels people seems to be more aware of the benefits of using public transport to the environment and are sensitive to the matter. On other hand, those results can be a consequence of better mobility policies and practices in Brussels, making more practical the use of public transport.

Table 4.11 - Reasons for using public transport when commuting (Surveys results).

Why do you use public transportation when commuting?	Brussels	Lisbon
Economic reasons	19,0	42,0
Environmental reasons	24,1	15,5
Quickness	17,2	9,4
More practical (e.g. lack of parking)	25,9	24,6
Has no driving license	10,3	4,7
Other	3,4	3,9

Regarding the reasons to use soft modes, they appear to be the same in both cities, essentially used for short distances and also as a complement to public transportation (Table 4.13). Once again the use of bicycles as complement to public transport appeared as a relevant factor, strengthening the importance of measures to integrate it with public transport.

Table 4.12 - Reason for walking or cycling in each city (Surveys results).

Why do you displace on foot or by bicycle?	Brussels (%)	Lisbon (%)
Deficient transport network (lack of transport in your area)	5,8	3,3
Economic reasons	2,3	13,1
Environmental reasons	5,8	8,5
Health reasons	15,1	8,8
Quickness	15,1	8,5
Short distances (1 to 2 km)	36,0	36,4
As a complement to public transportation	19,8	18,1
Other	0	3,3

In both cities the users seem satisfied with the transports services (Table 4.13). However, in Lisbon 33.9% of survey respondents said they were unsatisfied with the service, which is a considerable percentage.

Table 4.13 - Level of satisfaction of the users of the transport services in each city (Surveys results).

User satisfaction of the transports service		
Level of satisfaction (%)	Brussels	Lisbon
Very satisfied	11,8	2,5
Satisfied	72,5	60,4
Unsatisfied	11,8	33,9
Very unsatisfied	3,9	3,1

4.3.3 Intermodal Passenger Systems

In both cities more than 40% of the respondents to the surveys use two or more transport modes to travel daily (Table 4.14). The intermodal systems are focused essentially in this type of passenger that use more than one transport mode. These high percentages demonstrate the relevance of intermodality and the importance of the improvement in intermodal systems, not just to attract new users, but to also to the current passengers.

Table 4.14 - Number of different transport modes uses daily (Surveys results).

How many transport modes do you use daily?	Brussels (%)	Lisbon (%)
1	43,1	47,4
2	41,2	22,9
3 or more	11,8	19,1
I do not use daily	3,9	10,6

The question in Table 4.15 was done to understand the aspects, within some of the negative aspects related to interchanges, that needed some improvements in the perspective of the user.

Table 4.15 - Transport interchanges (Surveys results).

What do you think of the transport interchanges?	Brussels (%)	Lisbon (%)
Lack of security	21,2	28,2
Confusing information	16,7	21,0
Lack of seats	22,7	24,7
Inadequate temperature (cold or hot)	19,7	18,9
Other	19,7	7,3

Lack of security and lack of seats seems to be the two most negative aspects in both cities and in terms of information it appears to be more confusing in Lisbon. In that context, measures should be taken to improve those critical points. Some of respondents that selected the answer "other" mentioned that the passenger interchanges were in fact good or they did not have nothing negative to highlight, a few suggested other answers. In Lisbon, the rain in interchanges was mentioned as a negative aspect.

In terms of integration of the different transport modes, as the author could observe, there is a difference between both cities. In Brussels, the public transport is well connected within itself, but also with other transport system like car sharing, bike sharing and bicycles in general. Some examples are the design of some interchanges (making the correspondences easy), the designated areas for bicycles on trains and metro, stations accessibility for cyclist and "Park and Ride" facilities for cars and bicycles. It is noticeable that the concept of intermodality has been applied all over Brussels.

On the other hand, in Lisbon even that some improvements have been made, such as the integration of bicycle with public transport, there is still a lot do. It is necessary the implementation of other measures to complement the ones already taken.

4.3.4 Passenger Information Systems

Concerning the information provided to passengers about cities' transports it was noticed from the previous analysis that Brussels is far ahead from Lisbon, particularly real-time passenger information on board of the vehicles and about correspondences between transports. The survey results presented in Figure 4.48, where the transport users were asked to classify the information provided by public transport operators, made clear the differences between both cities. While in Brussels the information at stops in real-time and the information about correspondence on vehicles were classified with more than 50% as Good or Very Good, in Lisbon the same criteria were classified as Weak or Bad. Therefore, an intervention in these areas is required to address these weaknesses.

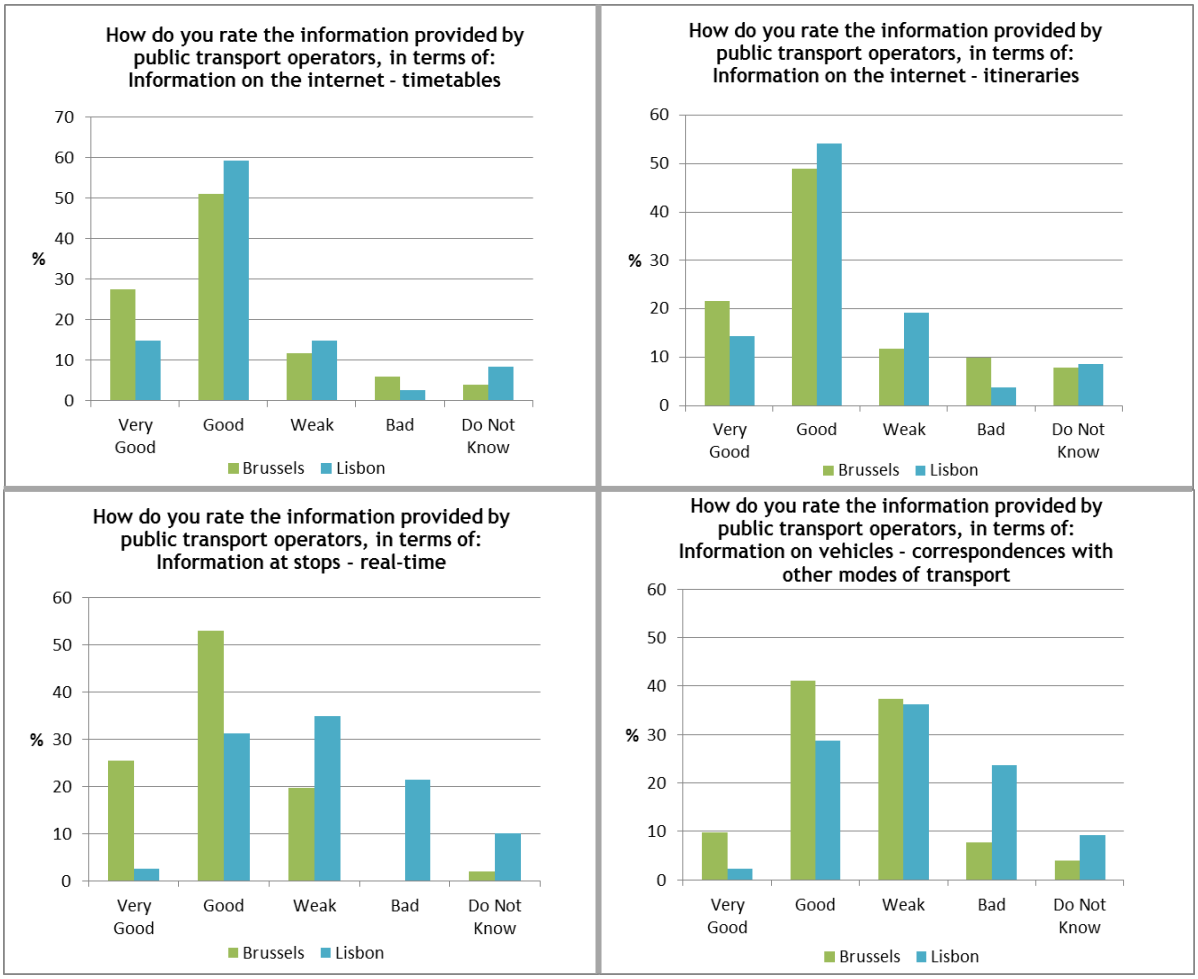

Figure 4.48 – Information quality in each city (Surveys Results).

The preferences of the users in terms of the communication of the information were also analysed. By comparing both cities, remarking if the choices are the same, it is possible to understand if some of the information system implemented in Brussels would be well accepted in Lisbon and for that reason a similar system can be implemented. These data are presented in Table 4.16.

Table 4.16 - Preference in terms of information by order of importance (Surveys results).

Brussels	Order of Importance	Lisbon
Information		Information
At stops, in real-time	More important	At stops, in real-time
In mobile applications, in real-time		At stops
On vehicles, in real-time		On vehicles, in real-time
On the operators website, in real-time	V	In mobile applications, in real-time
At stops	V	On the operators website
On vehicles		At mobile applications
At mobile applications	Less important	On the operators website, in real-time
On the operators website		On vehicles

In the Lisbon survey there was an error in the form online, and a misunderstanding in the interpretation of the question, visible in the results. For that reason, some of the data are compromised and the author cannot present them as accurate information (that data is presented in the table in grey). Nevertheless, it was possible to observe that the information in real-time was the preferred in both cities independently of the means. Being the information on the operators' website, "simple" or in real-time, considered as one of the less important.

The number of different mobile applications and websites available in Lisbon is incredible, but when the information is too much and very disperse it becomes a not so good service. On the other hand in Brussels the main operators have just one application, produced by themselves. The fact than in Lisbon there are different major operators must be the reason of this problem, created my market competition. However, some studies appointed that if they work together to the same propose, instead of competing with each other, they can actually increase their income.

4.3.5 Ticketing Systems

To start the analysis of the current ticketing systems in each city, it was asked to the public transport users how they usually pay their trips (Table 4.17). In Brussels about 70% of the respondents use a season ticket, contrasting to the 40% in Lisbon. One of the reasons may be the fact of the majority of the respondents are young people between 18 and 26 years old and students (Annex VI – Complete Brussels Mobility Survey Results) and in Brussels there is a significant discount for them in the use of public transport (126 Euro per year, 10.50 Euro per month, instead of 499 Euro per year).

Table 4.17 - Modality of trip payment (Surveys results).

How do you usually pay your trip on public transport?	Brussels (%)	Lisbon (%)
Season ticket/Pass	68,6	39,8
One journey or single ticket	23,5	46,3
Onboard ticket, bought to the driver	2,0	9,9
Other	5,9	4,0

The MTB season ticket in Brussels is a good example of an intermodal ticketing system, where for more 6.5 Euro than STIB season ticket is possible to have access to all public transport (urban bus, tram, metro and train from different operators). In Lisbon is not possible to have access to all public transport in the area with a season ticket.

Furthermore, with an on board ticket in a bus or tram in Brussels is possible to change to other public transport mode within one hour and in Lisbon that is not possible. Something should be done to allow that a bus ticket bought on board of a bus can also be used in other public transport

in order to promote intermodality. In the survey some of the respondents suggested the implementation of self-service ticket machine in bus stops or stations.

In Table 4.18 is presented the opinion of city users about the current fares of the public transport.

Table 4.18 - Opinion about the current fares (Surveys results).

What do you think of the current fares of the public transport?	Brussels (%)	Lisbon (%)
Adequate	19,6	4,7
Affordable	39,2	13,0
Expensive	41,2	78,7
Do not know	0	3,6

About 80% of the respondents in Lisbon mentioned that the current fares are expensive. In Brussels the opinion was more disperse, more balanced between affordable and expensive.

4.4 Main Conclusions of the Chapter

In this chapter was possible to conclude that Brussels and Lisbon present significant differences. In Brussels the measures to promote intermodality are evident, while in Lisbon a lot still needs to be done. It also made clear the necessity for improvements in Lisbon's public transports to a more intermodal passenger transport system, through integration of different transport modes and better information and ticketing system. Some of the points identified requiring developments are: interchanges' waiting areas; integration of bicycle in public transport; information about correspondences with other transport modes; real-time information to passengers pre-trip and on-trip, especially in buses and trams. In the next chapter are discussed some improvements to Lisbon mobility.

5 STRATEGIES FOR LISBON INTERMODAL MOBILITY SYSTEMS

After the analysis of the case studies and of the best practises being implemented all over Europe, it was possible to verify the weaknesses in Lisbon's intermodal passenger transportation and the important points to improve. In this chapter are presented some strategies to improve urban mobility in Lisbon. The aim is to guarantee citizens improved quality of life in a user-friendly environment. The proposed measures address all transport modes, placing high relevance on intermodal mobility in the perspective of the development of a new sustainable urban mobility culture.

5.1 First Approach of the Proposals

As a first approach to the definition of the final proposals we asked to the respondents in the Lisbon survey their opinion about some alleged measures in order to understand how city users would accept their implementation. The measures proposed in the survey and the answers are presented in Table 5.1.

Table 5.1 - Opinion of the respondentes about some suggested mesures (Lisbon survey results).

Practice or measure	Do not know	Irrelevant	Little relevance	Relevant	Very relevant
	%	%	%	%	%
Pay only for what you use (pay per km)	6,5	13,0	20,0	32,7	27,8
Travel with more people on the same ticket	5,2	15,2	21,7	33,6	24,2
Real-time information on vehicles of correspondences and their timetables	1,3	2,0	4,3	36,3	56,1
Real-time at all stations and stops	1,8	1,6	3,6	28,0	65,0
Information about the connection and whether it is the last vehicle	2,5	1,3	6,1	39,0	51,1
Quickest route information including different modes of transport	2,9	1,6	6,7	33,9	54,9
Real-time location of the vehicle	1,8	4,3	15,9	39,2	38,8
Real-time information on the capacity of transport (complete vehicle or not)	1,3	6,5	21,3	41,7	29,1
Signs at the stations identifying the entrance for bicycles on trains and not just on the train itself	6,3	5,2	19,7	42,6	26,2
Audio information of the carriage (train / metro / tram) designed for bicycles	7,8	11,0	28,0	31,8	21,3
Better access for bikes at stations	6,7	6,3	17,5	40,1	29,4
Real-time information about the space available for bicycles in public transport vehicles	7,2	9,0	25,8	34,5	23,5

Practice or measure	Do not know	Irrelevant	Little relevance	Relevant	Very relevant
	%	%	%	%	%
Bicycle presence in vehicles allowed at all hours	7,2	6,1	19,1	32,7	35,0
Student discount up to 26 years	5,4	2,0	1,8	17,3	73,5
Youth discount minor 26 years	5,6	3,1	5,2	17,5	68,6
Special discounts at the weekend, particularly over long distances	4,5	2,2	5,8	22,0	65,5
More car and bicycles parks at stations in outskirts of the city	5,6	3,1	8,3	29,1	53,8
More ways reserved for bicycles	6,3	5,4	12,3	30,7	45,3

Furthermore, when confronted with the question "What would you think of paying more for the service to have better conditions?" 69% answered that depending on the improvements they would possibly agree with an increase in tariffs. That demonstrates a perceived need for improvements and willingness of city users to contribute to them.

5.2 Final Proposals

The following set of measures propose to the city of Lisbon are presented organized by main theme.

5.2.1 Intermodal Strategies

Measure nº 1 – More seats and security in passengers' interchanges

Interchanges are very important for intermodality as the point of connection of the different transports. In train stations it is visible the need of improvements, being the lack of seats and security mentioned in the survey as some of the weaknesses of interchanges. Most of the passengers' seats are currently in the platforms, where especially in winter it is cold and unprotected from the rain, and few seats or even none are inside of the stations. This measure intends to install seats inside the stations, where passengers can be protected from weather conditions, providing better thermal comfort. Together with that, more information screens panels about next departures should also be installed. It is an easy measure to implement, since there is space in most of the stations, it is just barely exploited (Figure 5.1).

Figure 5.1 - Unused area at Entrecampos train station (Nádia Pedroso, 2015).

The train stations of Sete-Rios, Entrecampos and Roma-Areeiro have floors below the trains platform, with some unused areas where some seats and more screen monitor with information of next train departures can easily be installed. The Oriente train station is a good example that should be replicated in other stations.

In the Oriente bus station the same measure should be applied, as there is the possibility to do so in the lower floors of the bus station where there is a huge area available (Figure 5.2).

Figure 5.2 - Oriente bus station at left (Nádia Pedroso, 2015) and at right space below the station (Cabral, 2005).

Other solution involving more investment is the construction or adaptation when possible of some spaces to serve as passengers' waiting rooms, with seats available, panels providing details of train departures and also video camera security systems and air conditioning (Figure 5.3).

Figure 5.3 -Example of a waiting room in the train platform at Gatwick station, Britain (Silver Tiger, 2012).

Bicycles and Public Transport

Bicycles are definitely the best solution in distances smaller than 5 km and their integration with public transport actually expands the area of influence of public transports. Sometimes in cities with hills, like Lisbon, it becomes more difficult. However, solutions have been put in practice in other cities to reduce this fact that could be a problem and the integration with public transport is one of those solutions.

Measure nº 2 - Buses and Bicycles

Buses get people closer to their final destination but are bicycles that will take them to the "last mile".

For a first approach, it must start to identify the critical areas for cycling what means the higher slope areas/itineraries of the city. By using the "Slopes map of the road network" for Lisbon city and the actual Bike bus network we evaluate the coverage of this network and the areas that still need some solutions (more information in Annex II – Analysis of Bike bus service). In Figure 5.4 is identified the area considered most critical within which are the Carris line buses that should also carry bicycles.

Figure 5.4 - Identification of the area and bus lines to install the bicycle racks (Nádia Pedroso, 2015).

After identified the bus lines to integrate bicycles, it is necessary to reflect on how to transport them on buses.

The best solution to carry bicycles on buses is bike racks outside the bus, preferable on the front of the vehicle, so the bus driver can see when a passenger is loading or unloading a bicycle. In Figure 5.5 are some examples of bike racks for buses. These racks could carry 2 or 3 bicycles, with the advantage of not taking place inside buses. Besides that, it is a good solution for high floor buses, with stairs to get inside, or to adapt on buses that do not have enough space inside for bicycles.

Figure 5.5 - Example of bicycle racks outside buses (Bikes on Buses, 2015).

Different models of bike racks are available in the market, even for mini buses. For the mini bus (operating mostly in the old quarters of the city, where a common bus cannot go due to narrow streets) in Lisbon the author suggests the implementation of the bike rack on the back of the bus, because of their configuration (Figure 5.6).

Figure 5.6 - Carris mini-bus (Carris, n.d.-e).

Measure nº 3 – Bicycles on board of metros and trains

In the case of bicycles on board of metros and trains, the author suggests using upright racks. This type of bike racks allows a better use of the space available. The solution should be integrated with foldable seats, like in the Figure 5.7, so if the bike racks are not in use, passengers can sit. This racks should be implemented the closest possible to the doors.

Figure 5.7 – Examples of up right bike racks (TriMet, 2015, McGregor, 2014, and Lord, 2013).

In the case of trams is not recommended the integration with bicycles. They are small and do not have space inside, besides that the number of trams are very few.

Measure nº 4 – Cyclists' accessibility to stations

Access of cyclists to train stations and metro stations need to be improved. There are no adapted accesses to bicycles and in some stations is not clear if bicycles are allowed in escalators or not.

This measure aims to implement cycle wheel ramps in the both sides of the stairways of train and metro stations, making stairs accessible to cyclists (Figure 5.8). The wheeling ramps enable cyclists to go up or down staircases without having to physically carry their bike. Several

designs of ramps are available and can be installed both concrete and metal wheeling ramps. The success of a wheeling ramp mainly depends on the choice of ramp materials, as well as the gradient and length of the stairs (External Works, 2015).

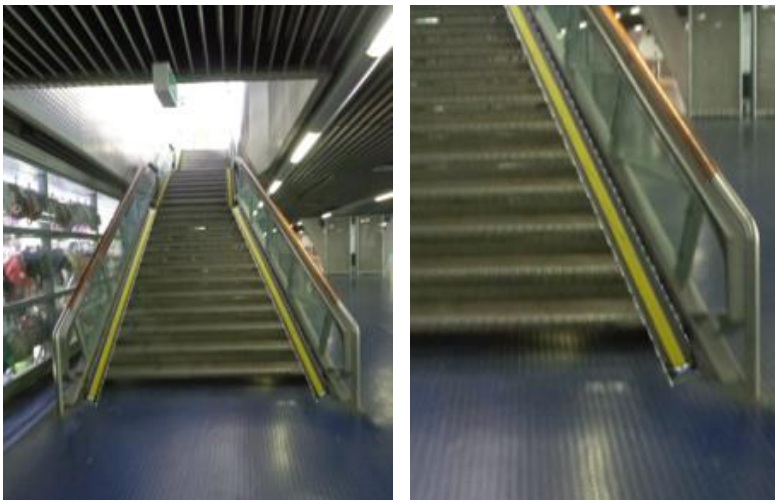

Figure 5.8 - Example of the propose cycle wheel ramp to the stairways of stations in Lisbon (Nádia Pedroso, 2015).

Measure nº 5 – Park and Ride facilities

The author proposes the implementation of free parking lots in the train and metro stations in the outskirt of the city for cars and bicycles. The aim of the measure is to reduce the number of cars entering in the city and consequently reduce congestion.

The metro stations of Odivelas, Amadora-Este, Pontinha and Senhor Roubado are some good solutions to the implementation of these parks since they are close to the city (Figure 5.9).

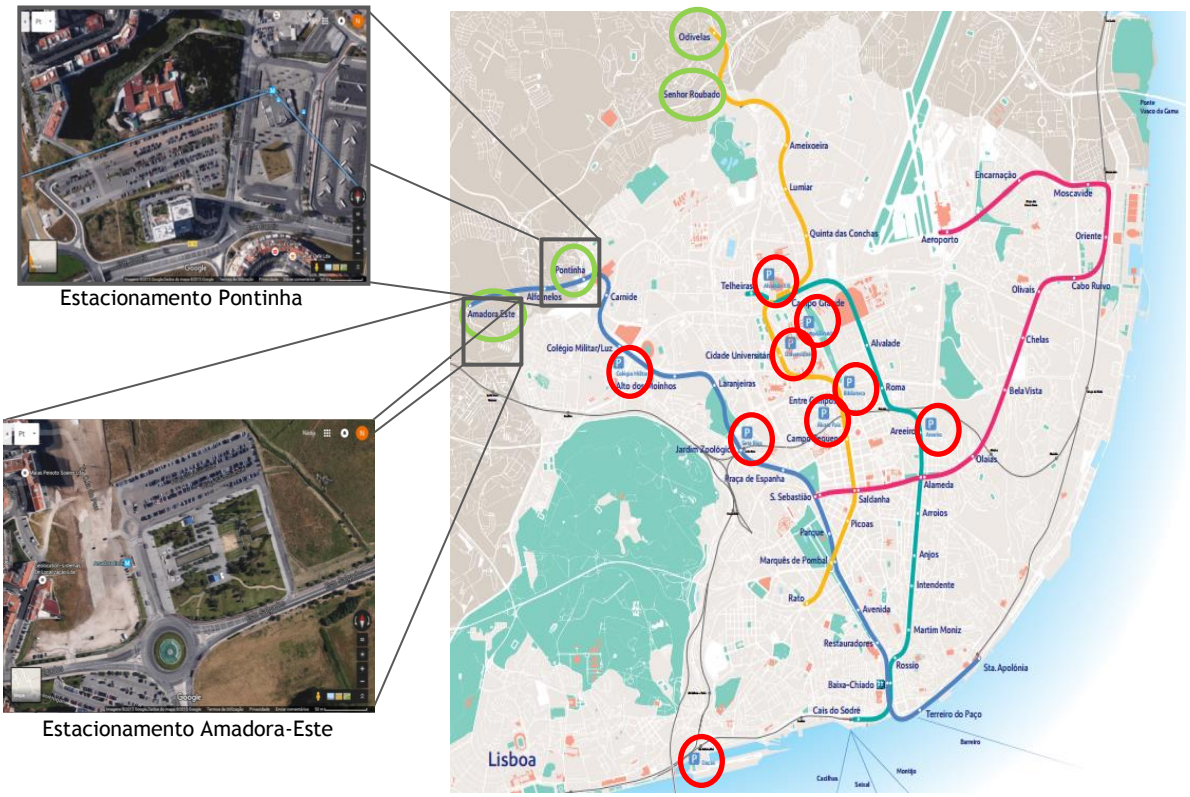

Figure 5.9- Identification of the proposed Park&Ride facilites (green circles) and the actual Park&Ride facilities in combination with the season ticket (red circles) (adapted from ML, 2014 and Google, 2015)

Although there are already some parking lots there, the conditions need to be improved as the security.

About bicycles parking, is recommended the implementation of more bike racks in the important agglomeration of people, like schools, universities, and business centres. Moreover, it should also be implemented secure bicycle parks.

5.2.2 Information Strategies

By analysing the surveys, observing the information published on the websites of operators or other entities and the information available at bus stops and metro or train stations, it was clear that in Lisbon public transports there is a lack of information which could contribute to a lower level in the quality of the service. For that reason, this is a field that must be improved, not just as a way to simplify intermodality but also every mono-system.

Measure nº 6 – Correspondence information panels

This measure pretends to implement information panels with more detailed information about connection with buses as shown in Figure 5.10 and Figure 5.11. It is an easy solution that can be adapted in the existing panels with the use of a sticker.

Figure 5.10 - Example of new proposed bus information in train station (Nádia Pedroso, 2015).

Figure 5.11 – Example of new proposed bus information in metro station (Nádia Pedroso, 2015).

The purpose of the measure is to assure an easy correspondence between bus and other public transport modes. Informing passengers about the exact exit of the stations to access a certain bus stop, by indicating the exact number of bus or tram line, helps the passenger when switching between modes of transport.

Measure nº 7 – Real-time information at stops

In Lisbon survey the importance of real-time information at stops to the users and the needs of improvements were obvious. By saying that, it is recommended the installation of more information displays at stops and more care with the information provided. When proceeding to the installation of new displays is advisable the implementation of a new model of display, similar to the ones in Brussels, so that more information can be provided, like information in case of disturbance or any novelties of the service.

Measure nº 8 – On board real-time passenger information

As demonstrated in the literature review and in the case studies, on board real-time passenger information is very helpful and contributes to the quality of the service. For those reasons the author recommends the implementation of a similar system to bus and tram of Lisbon. The on board system used in Brussels is a great example, informing among other things about the correspondences with other transport modes and thus promoting intermodality. The on board information system may consist on screen displays with real-time information about stops, correspondences with other transport modes (specifying the exact lines and correspondences with other operators) and disturbances on the transport network.

Since the investment necessary to the implementation and the time requested to do it are high, a transitional measure can be applied. The transitional measure (measure 8.1) consists in the application of a “printed paper stick” with the itinerary of the bus line (in the case of the same vehicle is used in different bus lines, should be applied all the itineraries usually used in that vehicle). Similar to the itinerary information provided in the more recent trams and in trains and metro with the upgrade of providing more detailed information about correspondences with other transport modes. In Figure 5.12 is proposed a form of presentation of itineraries to apply inside the

Figure 5.12 - Proposed information "sheet" with itinerary in both directions, using bus line 749 has an example (Nádia Pedroso, 2015).

buses.

The implementation inside the buses must be done preferably in more than one place and in visible places, such as above doors.

Measure nº 9 – Information in the trains and in the platforms for cyclists

Better information is needed in railway stations' platforms about the local of bicycles entry on the trains. As the local where the carriages stop is not always the same, the solution of a bicycle pictogram on the floor of the platforms is not advisable (like there is in Copenhagen). Nevertheless, there are other solutions that can facilitate the loading of bicycles and at the same time avoiding trains to spend more time at the stations.

One solution could be through audio information in stations about the designated carriage for bicycles at trains. As the operators inform passengers at stations about the destination of the next train, they can also inform about the designated carriage for bicycles. For example, by saying the carriage order and door: "Bicycles allowed in second carriage, last door".

Another solution is more visible signalization of the designated carriage for bicycles in the train as represented in Figure 5.13, allowing passengers to easily visualize it from far giving them time to move to the doorway.

Figure 5.13 - Example of the bicycle pictogram propose, in this case to the CP trains (Nádia Pedroso, 2015).

The combination of both solutions proposed might be also a plus.

Measure nº 10 – Information access for cyclists

This measure is related with measure nº 4, since it just make sense after the implementation of that measure.

The propose of this measure is the placing of bicycle pictograms, like the same in the Figure 5.14, in the cycle wheel ramps at stations stairways as method to define one-way ramps. The aim of the measure is to avoid the problem of two bicycles in opposite directions.

Figure 5.14 – Example of the proposed stairways bicycle pictogram, indicating the direction of bicycle in the cycle wheel ramp in the access to stations (Nádia Pedroso, 2015).

5.2.3 Ticketing Strategies

The ticketing systems presented numerous opportunities for improvements, not only in the tariff system but also in the payment system.

Measure nº 11 – One fare to all public transport in the same zone

This measure proposes the creation of a season ticket fare that allows the use of all public transports operating in the Lisbon area, similar to the MTB season ticket in Brussels. The aim of the measure is to promote intermodality between all the operators, widening the public transport network available to passengers. By doing that the public transport service will become more flexible and reaches more points of the city.

The main difficulty to the implementation of this measure is the existence of several different operators, public and private, in Lisbon. Since, the integration of the different public companies is visible but not the public with the private sector. The problem might be the method to distribute the revenues by the different operators.

Furthermore, the same should be applied to one day ticket and the single ticket. Nowadays, these tickets do not even include the CP trains, although it is already included in the season ticket. At least, those tickets should also be allowed in CP, avoiding the need to buy another ticket.

Measure nº 12 – Zapping limit of discounted cash per day

In the case of charge money tickets like Zapping is suggested the setting a maximum limit of discounted cash per day. Since a day ticket (24 hours ticket allowed at Carris and ML) cost 6 Euro, a measure should be done in order to when a passenger reaches that value with Zapping in one day, do not discount more money. With this measure the passengers with a Zapping ticket would not need to acquire a day ticket when they need to use public transport more times. Moreover, the passenger does not need to be worried with the number of trips and their costs, since there is a maximum limit per day.

Measure nº 13 – Zapping allowed on all operators: better intermodality

Allow the use of Zapping in all transport operators in Lisbon is a must. In the Lisbon survey some of the respondents suggested this measured or expressed their dissatisfaction concerning the limited use of Zapping. Once again this measure depends on collaboration and acceptance of the different operators.

Measure nº 14 – Purchase tickets easily: new paying system

To buy a bus ticket before boarding is often a difficult thing. In most of bus stops there is no place where to buy a ticket. One solution is going to the nearest metro station, but often there is none nearby. As a result, the only solution is to buy it to the bus driver, which is more expensive and makes the bus spend longer time at the stop.

In order to avoid that, a new paying system based in the use of new technologies such as SMS ticket is a good solution, following the new trends in some countries in Europe.

Another solution already being implemented in other countries (e.g. Britain) is the use of mobile apps to pay tickets. Exploring the potentialities of mobile applications seems the best solution for a future solution for Lisbon.

These solutions present significant advantages compared with the actual system in Lisbon and it is better than the implementation of self-service ticket machines as there is in Brussels, since its implementation is less expensive. This measure is particularly useful in the case of buses, since it is the most problematic system in Lisbon. However, its use can be expanded to all public transport system.

The aim of this measure is to facilitate the passenger's life and to prevent buses wasting time at stops selling tickets to the customers.

5.2.4 Synthesis of the Proposed Strategies

In Table 5.2 is presented the synthesis of the measures proposed with the level of difficulty and costs of implementation. This pretends to facilitate to prioritize the measures.

Table 5.2 - Synthesis of the proposed measures with the level of difficulty and costs of implementation.

Type	N°	Measure	Level of difficulty	Implementation Costs
Intermodal Strategies	1	More seats and security in passengers' interchanges	Medium	Medium
	2	Buses and Bicycles	Low	Medium
	3	Bicycles on board of metros and trains	Low	Medium
	4	Cyclists' accessibility to stations	Low	Medium
	5	Park and Ride facilities	Medium	High
Information Strategies	6	Correspondence information panels	Low	Low
	7	Real-time information at stops	Medium	Medium
	8	On board real-time passenger information	High	High
	8.1	Transitional measure of on board passenger information	Low	Low
	9	Information in the trains and in the platforms for cyclists	Low	Low
	10	Information access for cyclist	Low	Low
Ticketing Strategies	11	One fare to all public transport in the same zone	Medium	Low
	12	Zapping limit of discounted cash per day	Low	Low
	13	Zapping allowed on all operators: better intermodality	Low	Low
	14	Purchase tickets easily: new paying system	Low	Low

In general the difficulty and costs of implementations of the proposed measures are Low. This set of strategies put together could bring significant improvements in Lisbon mobility by turning the use of public transport more easy and comfortable and by promoting intermodality.

6 CONCLUSIONS

Given the growing population in urban areas, the high concentration of jobs and schools, and the large number of daily commuters, urban mobility has become an important issue. It does not only have consequences to the environment as also affects the economic and social development. An efficient urban mobility strategy contributes to the quality of life of citizens while minimizing the environmental impact of transports (e.g. by reducing CO_2 emissions) and stimulating economy.

The pathway to an urban sustainable mobility involves strengthening of intermodal mobility. Intermodality has been mentioned by different authors as an important concept to improve the public transport and the whole mobility system in and around urban areas, where the congestion problem is often localized and more evident. Different factors like infrastructures and information and ticketing systems are relevant to the goal of a door-to-door seamless and ease intermodal passenger transport in order to reduce the dependence on the private vehicle as the major mode of ground transportation and increase use of public transport. More and more, throughout Europe the growing efforts to improve intermodality by the implementation of several measures are noticeable and the results have been positive.

With this work it was possible once again to verify the benefits of intermodality and the relevance that interchanges, collaboration between transport operators, the integration of the different transports and information and ticketing systems have in its success.

The research method used in this dissertation combined literature review, analysis of study cases, field observation and surveys to city users to reach the final purpose. This combination allowed to obtained important lesson to improve mobility in Lisbon.

As the author could observe, the city of Brussels has been significantly improving in the different important aspects of intermodal passenger transportation. Some of that examples are: the integration of bicycles in the mobility system through bike sharing or the creation of condition for cyclist (e.g. parking and designed places for the carry of bicycles in public transport vehicles); a real-time information system of good quality, not just at stops and stations but on board of vehicles and on websites or mobile applications; and even in the collaboration between the several mobility agents. For those reasons, Brussels proved to be a good example to other cities like Lisbon, where the implementation of some of these measures could be really meaningful in the improvement of the quality of the public transport services and by consequence to the modal transfer.

Following the tendency of other cities, in Lisbon the demand for integration of bicycles with public transports is increasing. Cycling has proven to be a powerful solution to complement public transport service, besides all the benefits of its use to a healthier environment. However, the current measures to the integration of bicycles in public transport are still weak, presenting low levels of satisfaction and need of upgrading. In the study we identified the need of improvements

in different levels: designated spaces for bicycle in vehicles (inside or outside); stations' accessibility; secure parking; and information.

Transport interchanges represent a crucial point when corresponding between different transport modes. For that reason, interchanges needs special attention when the objective is intermodality. It is not just a matter of infrastructure but also security and information available. In that matter, it was recognized some useful information that helps passengers to change transport in an ease way, such as more detailed information about correspondences with buses in metro and train stations. The implementation of such practices is recommended to Lisbon city.

When comparing Lisbon with Brussels, the differences in the quality of the transport services mostly in terms of information systems available were visible. The information provided by the public transport in Brussels is of very good quality what gives the service more reliability. While in Lisbon the level of information provided and the quality need significant improvements. The weakest point is real-time information and it is definitely a requisite of passengers. In terms of information through mobile applications (available for travellers to plan and schedule their journey), in spite of the several applications available in the city, the level of satisfaction is low and they are not very known. However, during the realization of this work, it was noticeable how fast this mode of providing information are getting better and are continuously emerging new applications to Lisbon's transports with an intermodal perspective. In this dissertation became evident that information contributes to a transparent choice in travel options and therefore is a crucial factor to achieve a high performance service.

What appears to be the problem in Lisbon, that could be one of main reason for a weak intermodality, is the existence of public and private transport operators, making collaboration difficult. This is a problem requiring an urgent measure from public authorities in the field, since mobility is of great importance for citizens. The main barrier to an integrated ticketing system for all transports in Lisbon seems to be the result of lack of collaboration of the different transport operators in the city. Therefore, is of extreme importance enhance the cooperation between all the mobility stakeholders. In Brussels besides the fact that public transport operators are public companies, they participate and collaborate with other private companies. For example the public transport operator STIB has also a part in the car sharing company Cambio and also cooperates with taxis through the Taxi COLLECTO service (a service that complements the night bus service of STIB). These collaborations have benefits for both companies. The different stakeholders should not see each other as competitors but as important pieces of a larger system, where by combining the strengths of various transportation options, bring each mode up to full strength, exploring existing and creating new synergies and utilising technology potentials (making use of the existing trends) made them more competitive and a better option of mobility.

The expected outcomes of the proposed strategies to Lisbon are making public transport more attractive to people, and as a result reducing the use of private vehicle, especially in urban areas. And, in the long-term, increase the number of people using public transport, reduce pollutant emissions, particulate matter and noise levels and generally improve living and working

conditions in the city. Those measures should and must be accompanied by public awareness on the subject, showing the citizens the benefits of the services and never forgetting to keep the user informed of any changes in the service.

Nevertheless, although intermodal mobility is important, other measures of sustainable mobility policies like the use of clean vehicles should not be forgotten. And in order to create a more sustainable mobility culture is need more campaigns addressing behaviour and attitudes.

6.1 Future Developments

The subject addressed in the current dissertation has many possibilities for further studies. Some of the most relevant suggested by the author are:

- The evaluation of the positive impacts in environment of the proposed strategies and the potential revenues of the implementations of such measures, evaluating the costs of implementation of the measures and their outcomes.
- In order to proceed with the set of strategies proposed in this work, would be necessary the elaboration of a full plan of the measures, with more detailed information, such as the mention of all locals where the measure is going to be applied, number of material/equipment required, time need to implementation and also the costs associated.
- Since the cooperation between all the stakeholders is one of the factors to a successful intermodal mobility ecosystem and the necessity of more collaboration is needed, seems fundamental the development of a new management strategy and transport policies to the transports in Lisbon, in order to integrate public and private companies for a better intermodal mobility.
- Last but not least, a developed study about mobile applications, what works in the view of the user, analysing the factors to a successful one. The way of approach sometimes must be different, especially in the case of some information systems. When changing between transports, it could be difficult to find the other stop or station if you are not a regular user. A good transport system must be easy not just for regular users, but for all users.
- Furthermore, the impact of solutions such as the discounts in public transports for students or young people and at weekends should be analysed, since it has been clear the interest of survey respondents in this type of measures. However, this issue was not addressed in the strategies because it was considered outside the scope of analysis.

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ANNEXES

Annex I - Lisbon Transports Maps

Figure A1.1 - Lisbon transports maps (Carris, 2014b).

Figure A1.2 - Lisbon Metropolitan network diagram (ML, 2015c).

Annex II – Analysis of Bike bus service

Analysis of the service Bike bus of Carris and its relation with the high slopes roads in Lisbon, where the access by bicycle is difficult and evaluation of the lacks on this bus service in order to propose the adaption of bicycle racks outside Carris buses.

The buses, trams and funiculars, all services of Carris, are the public transports of the areas identified as more problematic (near Downtown).

Figure A2.1 - Bike Bus Network in Lisbon (Carris,n.d.-b).

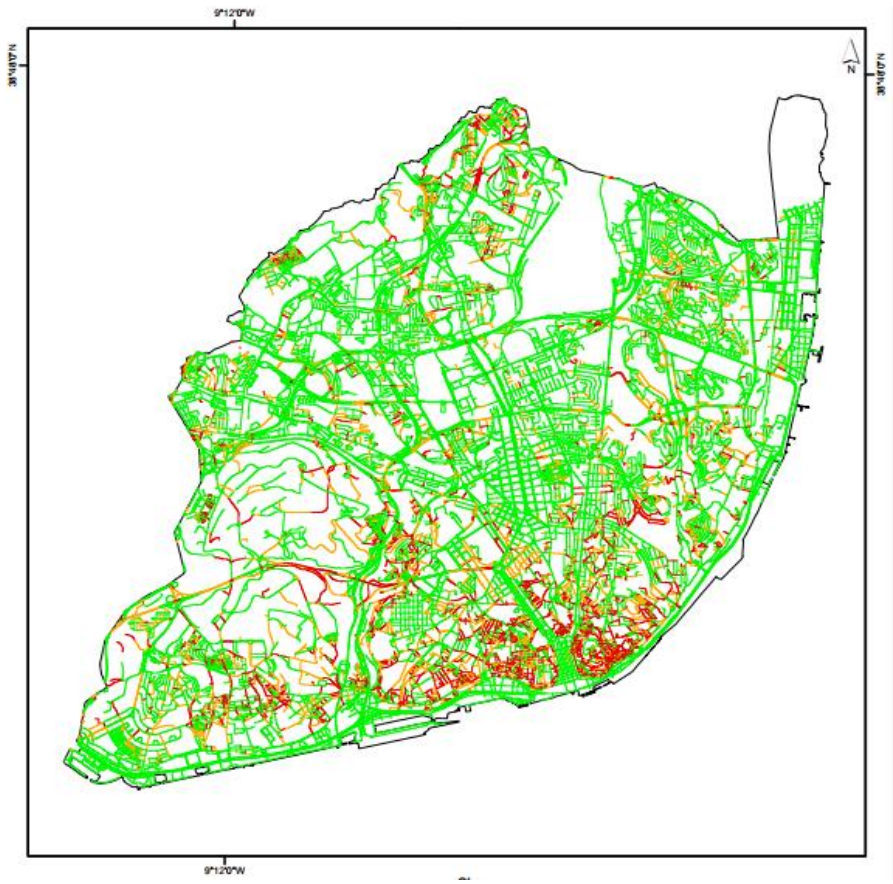

Figure A2.2 - Slopes map of the road network in Lisbon (Green less than 5%; Yellow: 5% to 8%; Red: more than8 %) (source: CML,*Mapa de declives da rede viária*).

Figure A2.3 - Analysis of the critical area for cycling and the need of Bike Buses (Nádia Pedroso, 2015).

Annex III – Public transport network in Brussels

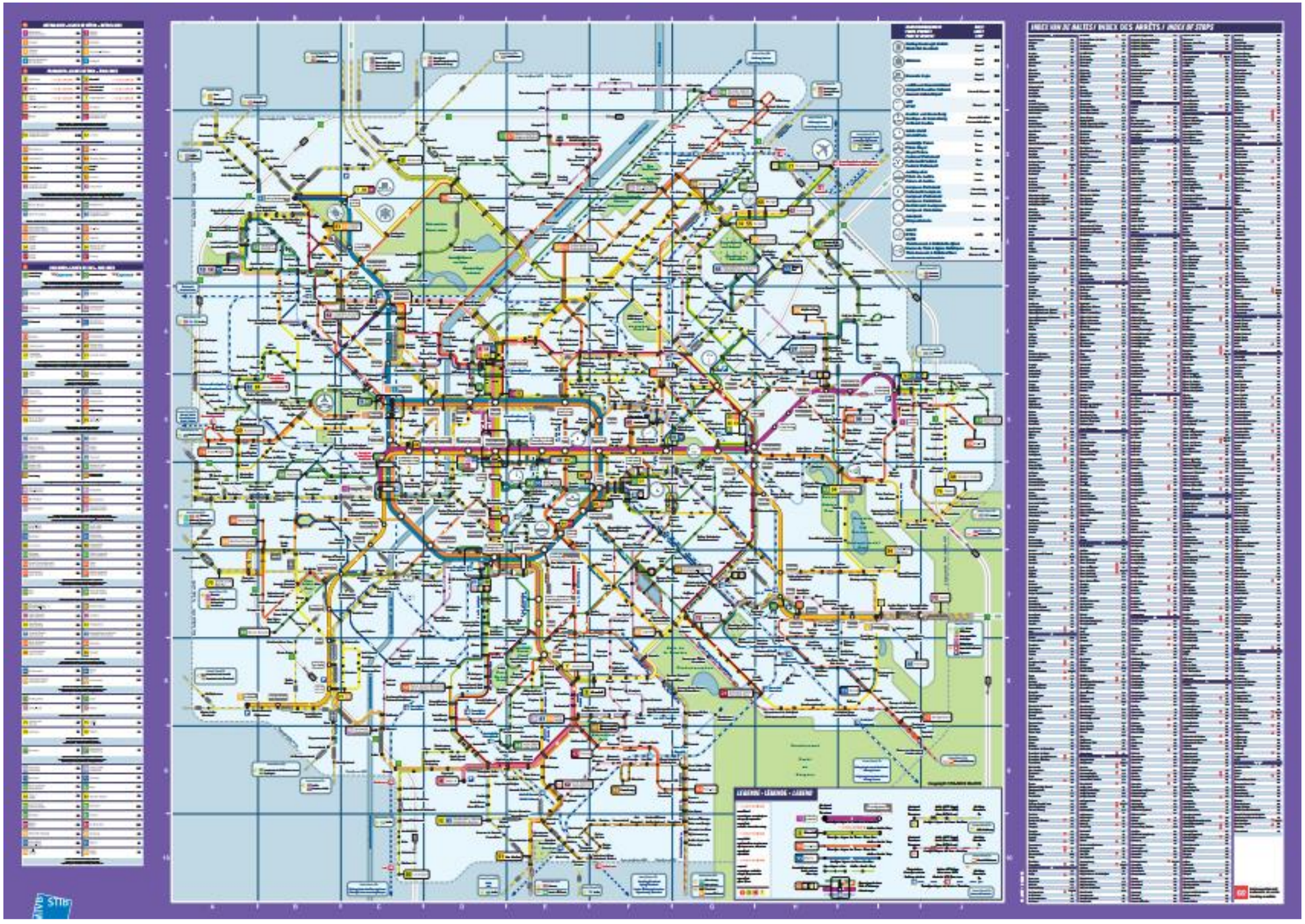

Figure A3.1 - Public transport network in Brussels Capital Region (STIB, 2015b).

Annex IV – Brussels Mobility Survey

Enquête sur la Mobilité Urbaine: Bruxelles

Étude intégré dans Mémoire de Master en Ingénierie de l'Environnement, Université Libre de Bruxelles et Universidade Nova de Lisboa.

Cette enquête prendra 10 minutes de votre temps!

* Required

Groupe I – Habitudes de Mobilité

1. **1. Avez-vous accès à une voiture? ***
   Mark only one oval.
   - ◯ Oui
   - ◯ Non

2. **2. Utilisez-vous les transports en commun à Bruxelles? ***
   Mark only one oval.
   - ◯ Oui *Skip to question 4.*
   - ◯ Non

Groupe I - Habitudes de Mobilité

Option "Non"

3. **2.1. Pourquoi n'utilisez-vous pas les transports en commun à Bruxelles? ***
   Check all that apply.
   - ☐ Réseau de transports insuffisante (manque de transport dans votre quartier)
   - ☐ Temps d'attente élevé
   - ☐ Temps de voyage élevé
   - ☐ Nombre de correspondance élevé
   - ☐ Temps d'attente entre la correspondance élevé
   - ☐ Manque d'information aux passagers (par exemple: horaires ou tarifs)
   - ☐ Conditions météorologiques (pluie, neige)
   - ☐ Insécurité
   - ☐ Confort
   - ☐ Other: _____

Skip to question 12.

Groupe I - Habitudes de Mobilité

Option "Oui"

4. **2.2. À quelle fréquence utilisez-vous les transports en commun à Bruxelles?** *
Mark only one oval.

- ◯ Rarement (moins d'une fois par mois)
- ◯ Occasionnellement (au moins 1 fois par mois)
- ◯ 1 à 3 fois par semaine
- ◯ Régulièrement (chaque jour)

5. **2.3. Utilisez-vous les transports en commun dans vos déplacements maison/travail/étude?** *
Mark only one oval.

- ◯ Oui
- ◯ Non *Skip to question 12.*

Groupe I - Habitudes de Mobilité

Option "Oui" continuation

6. **2.3.1. Pourquoi utilisez-vous les transports en commun pour vos déplacements maison/travail/étude?** *
Check all that apply.

- ☐ Raisons économiques
- ☐ Raisons environnementales
- ☐ Plus rapide
- ☐ Plus pratique (par exemple, manque de stationnement)
- ☐ Je n'ai pas le permis de conduire
- ☐ Other: _____

7. **2.3.2. Quel est le nom de l'arrêt de départ?**

_____

8. **2.3.3. Quel est le nom de l'arrêt d'arrivée?**

_____

9. **2.3.4. Quelle est la distance, en km, entre votre domicile et votre travail/école?**
Mark only one oval.

- ◯ Moins de 3 km
- ◯ Entre 3 et 6 km
- ◯ Entre 6 et 10 km
- ◯ Entre 10 et 20 km
- ◯ Entre 20 et 40 km
- ◯ Plus de 40 km

10. **2.3.5. Combien de temps prenez-vous pour y arriver?**
(compter avec le temps d'attente)

_____

11. **2.3.6. Combien de ce temps est passé dans les transports en commun?**

_____

Groupe I - Habitudes de Mobilité

Mobilité douce

12. **1. Vous déplacez-vous à pied ou à vélo?** *
Mark only one oval.

- ◯ Oui *Skip to question 14.*
- ◯ Non

Groupe I - Habitudes de Mobilité

Mobilité douce option "Non"

13. **1.1. Pourquoi ne vous déplacez-vous pas à pied ou à vélo?** *
Check all that apply.

- ☐ Conditions météorologiques (pluie, neige)
- ☐ Inclinaison des rues (nombreuses montées et descentes)
- ☐ Manque de voies réservées aux vélos
- ☐ Insécurité dans les routes
- ☐ Manque d'infrastructures au travail ou à l'école comme, par exemple, parking réservé ou douches et vestiaires
- ☐ Other: _____

Skip to question 16.

Groupe I - Habitudes de Mobilité

Mobilité douce option "Oui"

14. **1.2. Pourquoi vous déplacez-vous à pied ou à vélo?** *
Check all that apply.

- ☐ Réseau de transports insuffisante (manque de transports dans votre quartier)
- ☐ Raisons économiques
- ☐ Raisons environnementales
- ☐ Raisons de santé
- ☐ Plus rapide
- ☐ Petites distances (1 à 2 km)
- ☐ Comme complément au transport en commun
- ☐ Other: _____

15. **1.3. À quelle fréquence vous déplacez-vous à pied ou à vélo? ***

Mark only one oval.

- ◯ Rarement (moins d'une fois par mois)
- ◯ Occasionnellement (au moins 1 fois par mois)
- ◯ 1 à 3 fois par semaine
- ◯ Régulièrement (chaque jour)

Groupe II - Intermodalité

16. **1. Combien de moyens de transport (vélo/moto/voiture/bus/tram/métro/train /taxi/etc.) utilisez-vous pour vous déplacer régulièrement (seulement dans un trajet): ***

Mark only one oval.

- ◯ 1 *Skip to question 20.*
- ◯ 2
- ◯ 3 ou plus
- ◯ Je n'utilise pas régulièrement *Skip to question 20.*

Groupe II - Intermodalité

Option "2" ou "3 ou plus"

17. **1.1. Combien de temps passez-vous en attendant le(s) prochain(es) transport(s)? ***

Mark only one oval.

- ◯ Moins de 5 minutes
- ◯ 5 à 10 minutes
- ◯ 10 à 15 minutes
- ◯ 15 à 20 minutes
- ◯ 20 à 30 minutes
- ◯ Plus de 30 minutes

18. **1.2. Quelle est la distance entre la correspondance? ***

Mark only one oval.

- ◯ Dans le même arrêt
- ◯ 0 à 20 m
- ◯ 20 à 50 m
- ◯ 50 à 100 m
- ◯ Plus de 100 m

19. **1.3. Pour un nouvel utilisateur pensez-vous que c'est facile à trouver la correspondance?**

Mark only one oval.

- ◯ Oui
- ◯ Non

Groupe II - Intermodalité

Continuation

20. **1. Classer de 1 à 6 :** *

1=Moins important et 6=Plus important (une réponse par col)
Mark only one oval per row.

	1	2	3	4	5	6
Temps d'attente entre correspondance	◯	◯	◯	◯	◯	◯
Informations disponibles (temps réel, horaires et localisation dans le site web, application mobile, arrêts ou véhicules)	◯	◯	◯	◯	◯	◯
Distance entre gares ou arrêts	◯	◯	◯	◯	◯	◯
Coordination avec d'autres transports	◯	◯	◯	◯	◯	◯
Prix intermodal (tarifs pour utilisation de différents moyens de transport)	◯	◯	◯	◯	◯	◯
Infrastructures appropriés (par exemple: parking voitures/motos/vélos dans les gares, espaces dédiés aux vélos dans le bus/tram/train/métro, etc.)	◯	◯	◯	◯	◯	◯

21. **2. Que pensez-vous des locaux de correspondance de moyens de transport?** *

Check all that apply.

- ☐ Manque de sécurité
- ☐ Information confuse
- ☐ Manque des sièges
- ☐ Température inadéquate (froid ou chaud)
- ☐ Other: _____

Groupe III - Systèmes d'Information

22. **1. Évaluer l'information fournie pour les opérateurs de transports en commun à Bruxelles, à savoir :** *

Mark only one oval per row.

	Très bien	Bien	Pas très bien	Pas du tout	Ne sait pas
Information sur le site web – Horaire	◯	◯	◯	◯	◯
Information sur le site web – Itinéraire	◯	◯	◯	◯	◯
Information sur l'application mobile	◯	◯	◯	◯	◯
Fiabilité de l'heure prévue de passage du véhicule dans l'arrêt	◯	◯	◯	◯	◯
Fiabilité de l'heure prévue d'arrivé à la destination	◯	◯	◯	◯	◯
Temps-réel dans les arrêts	◯	◯	◯	◯	◯
Information en temps-réel dans les véhicules	◯	◯	◯	◯	◯
Information sonore dans les véhicules	◯	◯	◯	◯	◯
Information sur les correspondances dans les véhicules (correspondance avec d'autres transports et d'autres opérateurs)	◯	◯	◯	◯	◯
Panneaux avec la localisation de l'arrêt de correspondance (quand la correspondance n'est pas dans le même arrêt)	◯	◯	◯	◯	◯
Information en cas de perturbation du service	◯	◯	◯	◯	◯

23. **2. Classer de 1 à 8, l'existence d'information au passager:** *

1 = Moins important et 8 = Plus important (une réponse par col)

Mark only one oval per row.

	1	2	3	4	5	6	7	8
Dans les arrêts	◯	◯	◯	◯	◯	◯	◯	◯
Dans les arrêts en temps-réel	◯	◯	◯	◯	◯	◯	◯	◯
Dans les véhicules	◯	◯	◯	◯	◯	◯	◯	◯
Dans les véhicules en temps-réel	◯	◯	◯	◯	◯	◯	◯	◯
Sur le site web	◯	◯	◯	◯	◯	◯	◯	◯
Sur le site web en temps-réel	◯	◯	◯	◯	◯	◯	◯	◯
Sur les applications mobiles	◯	◯	◯	◯	◯	◯	◯	◯
Sur les applications mobiles en temps-réel	◯	◯	◯	◯	◯	◯	◯	◯

24. **3. Suggestions d'amélioration au niveau de l'information disponible aux passagers. Sur quoi aimeriez-vous être informé?**

_____

_____

_____

_____

_____

Groupe IV - Tarifs et titres

25. **1. Que pensez-vous des tarifs actuels des transports en commun à Bruxelles?** *
Mark only one oval.

- ◯ Adéquat
- ◯ Accessible
- ◯ Cher
- ◯ Ne sait pas

26. **2. Comment payez-vous normalement votre voyage en transport en commun?** *
Mark only one oval.

- ◯ Abonnement sur la carte MOBIB
- ◯ Titres à la prestation (1 voyage, 10 voyages, aller-retour...) sur la carte MOBIB ou MOBIB basic
- ◯ Tickets à oblitérer (JUMP 1 voyage, 10 voyages, aller-retour...)
- ◯ Titre acheté au chauffeur
- ◯ Je n'utilise pas les transports en commun
- ◯ Other: _____

27. **3. Sélectionnez les opérateurs de transports en commun que vous utilisez:** *
Check all that apply.

- ☐ STIB
- ☐ TEC
- ☐ De Lijn
- ☐ SNCB
- ☐ Je n'utilise pas les transports en commun
- ☐ Other: _____

28. 4. Avez-vous suggestion(s) d'amélioration au niveau de tarifs et titres de transports?

.....

.....

.....

.....

.....

Groupe IV

29. **1.En tant qu'usager du transport en commun, que penseriez-vous de :** *

Mark only one oval per row.

	Très pertinent	Pertinent	Peu pertinent	Pas du tout pertinent	Ne sait pas
Payer seulement ce que vous utilisez (payer par km)	◯	◯	◯	◯	◯
Voyager avec plusieurs personnes avec le même titre de transport	◯	◯	◯	◯	◯
Information en temps-réel dans les véhicules à propos de correspondance et ses horaires	◯	◯	◯	◯	◯
Signalisation dans les gares de l'entrée pour vélos	◯	◯	◯	◯	◯
Meilleur accès des vélos aux gares/arrêts	◯	◯	◯	◯	◯
Plus d'espace pour les vélos dans les transports	◯	◯	◯	◯	◯
Un seul prix d'abonnement pour les transports en commun et systems de vélos dans la même région (n'importe pas l'opérateur)	◯	◯	◯	◯	◯
Information en temps-réel de la capacité du véhicule	◯	◯	◯	◯	◯
Information en temps-réel sur l'espace disponible pour les vélos dans les véhicules (bus/tram/métro/train)	◯	◯	◯	◯	◯
Vélos autorisé dans les rames de métro et dans les tramways à toute heure	◯	◯	◯	◯	◯
Réduction jeune moins de 26 ans	◯	◯	◯	◯	◯
Information exacte sur les correspondances	◯	◯	◯	◯	◯
Information sur le trajet le plus rapide incluant les différents modes de transports dans la ville	◯	◯	◯	◯	◯
Information sur les postes de vélos (Villo) dans les véhicules	◯	◯	◯	◯	◯
Plus parkings voiture/moto/vélo dans les grandes gares ou stations d'accès à la ville	◯	◯	◯	◯	◯
Plus de voies réservées aux vélos	◯	◯	◯	◯	◯

36. **O que acharia de:** *

Mark only one oval per row.

	Irrelevante	Pouco Relevante	Relevante	Muito Relevante	Não sei
Pagar somente o que utiliza (pagar por km)	◯	◯	◯	◯	◯
Viajar com mais pessoas num mesmo bilhete	◯	◯	◯	◯	◯
Informação em tempo real nos veículos das correspondências e seus horários	◯	◯	◯	◯	◯
Tempo real em todas as estações e paragens	◯	◯	◯	◯	◯
Informação sobre a conexão e sobre se é o ultimo veiculo	◯	◯	◯	◯	◯
Informação do percurso mais rápido incluindo diferentes modos de transporte	◯	◯	◯	◯	◯
Localização em tempo real do veiculo	◯	◯	◯	◯	◯
Informação em tempo real sobre a lotação do transporte (veículo completo ou não)	◯	◯	◯	◯	◯
Sinalização na estação do local de entrada para as bicicletas nos comboios e não apenas no próprio comboio	◯	◯	◯	◯	◯
Informação sonora da carruagem (comboio/metro/eléctrico) destinada às bicicletas	◯	◯	◯	◯	◯
Melhores acessos para as bicicletas nas estações	◯	◯	◯	◯	◯
Informação em tempo real do espaço para a bicicleta nos veículos de transporte público	◯	◯	◯	◯	◯
Presença de bicicletas nos veículos permitida em todas as horas	◯	◯	◯	◯	◯
Desconto estudante	◯	◯	◯	◯	◯
Desconto jovem menor de 26 anos	◯	◯	◯	◯	◯
Descontos especiais ao fim de semana, principalmente em longas distâncias	◯	◯	◯	◯	◯
Mais parques de estacionamento carros e bicicletas nas estações nos arredores/acessos à cidade	◯	◯	◯	◯	◯
Mais vias reservadas às bicicletas	◯	◯	◯	◯	◯

35. **4. Nombre des personnes qui constituent ménage** *

Mark only one oval.

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6
- ◯ 7
- ◯ 8
- ◯ 9
- ◯ 10
- ◯ Plus de 10

36. **5. Revenu mensuel du ménage** *

Mark only one oval.

- ◯ Moins de 1500€
- ◯ De 1501€ à 3000€
- ◯ De 3001€ à 5000€
- ◯ Plus de 5000€

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Annex V – Lisbon Mobility Survey

Inquérito sobre a Mobilidade Urbana: Lisboa

Estudo integrado na Dissertação de Mestrado Integrado em Engenharia do Ambiente, Universidade Nova de Lisboa e Université Libre de Bruxelles.

Este inquérito não demorará mais de 10 minutos!

* Required

Informações Pessoais

1. **Idade:** *
   Mark only one oval.
   - ◯ Menos de 18 anos
   - ◯ 18 a 26 anos
   - ◯ 27 a 44 anos
   - ◯ 45 a 64 anos
   - ◯ Mais de 64 anos

2. **Género:** *
   Mark only one oval.
   - ◯ Feminino
   - ◯ Masculino

3. **Ocupação:** *
   Mark only one oval.
   - ◯ Estudante
   - ◯ Trabalhador
   - ◯ Desempregado
   - ◯ Reformado
   - ◯ Other: _____

4. **Número do agregado familiar:** *
Mark only one oval.

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6
- ◯ 7
- ◯ 8
- ◯ 9
- ◯ 10
- ◯ Mais de 10

5. **Rendimento familiar mensal:** *
Mark only one oval.

- ◯ Menos de 600€
- ◯ 601€ a 1200€
- ◯ 1201€ a 3200€
- ◯ Mais de 3200€

Hábitos de Mobilidade

6. **Tem viatura própria ou tem acesso a uma?** *
Mark only one oval.

- ◯ Sim
- ◯ Não

7. **Usa o transporte público de Lisboa?** *
Mark only one oval.

- ◯ Sim *Skip to question 9.*
- ◯ Não

Hábitos de Mobilidade II

8. **Porque não utiliza o transporte público de Lisboa?** *

Check all that apply.

- [ ] Rede de transporte deficitária (falta de transporte na sua região)
- [ ] Tempo de espera elevado
- [ ] Tempo de viagem elevado
- [ ] Número de transbordos/correspondências elevado
- [ ] Tempo de espera entre transbordo/correspondência elevado
- [ ] Falta de informação ao passageiro (por exemplo: horários ou tarifas)
- [ ] Condições meteorológicas como chuva, frio ou calor
- [ ] Insegurança
- [ ] Conforto
- [ ] Other: _____

Skip to question 17.

Hábitos de Mobilidade II

9. **Com que frequência utiliza o transporte público em Lisboa?** *

Mark only one oval.

- ◯ Raramente (menos de uma vez por mês)
- ◯ Ocasionalmente (pelo menos 1 vez por mês)
- ◯ 1 a 3 vezes por semana
- ◯ Diariamente

10. **Utiliza o transporte público nas deslocações casa/trabalho/escola?** *

Mark only one oval.

- ◯ Sim
- ◯ Não *Skip to question 17.*

Hábitos de Mobilidade II - continuação

11. **Porque usa o transporte público nas deslocações casa/trabalho/escola?** *

Check all that apply.

- [ ] Razões económicas
- [ ] Razões ambientais
- [ ] Rapidez
- [ ] Mais prático (por exemplo, falta de estacionamento)
- [ ] Não tem carta de condução
- [ ] Other: _____

12. **Qual o nome da paragem/estação de Partida?**

_____

13. **Qual o nome da paragem/estação de Destino?**

_____

14. **Qual é a distância, em km, que percorre de sua casa até ao trabalho/escola?**
Mark only one oval.

- ◯ Menos de 3 km
- ◯ Entre 3 a 6 km
- ◯ Entre 6 a 10 km
- ◯ Entre 10 a 20 km
- ◯ Entre 20 a 40 km
- ◯ Mais de 40 km

15. **Quanto tempo, em minutos, demora a chegar ao destino?**
(contar com o tempo de espera)

_____

16. **Quanto desse tempo, em minutos, é passado dentro do transporte público?**

_____

Hábitos de Mobilidade III
Mobilidade suave

17. **Desloca-se a pé ou de bicicleta em Lisboa?** *
Mark only one oval.

- ◯ Sim *Skip to question 19.*
- ◯ Não

Hábitos de Mobilidade IV

18. **Porque não se desloca a pé ou de bicicleta?** *
Check all that apply.

- ☐ Condições meteorológicas como chuva, frio ou calor
- ☐ Declive das ruas (inclinação das ruas)
- ☐ Falta de vias reservadas às bicicletas
- ☐ Insegurança na estrada
- ☐ Falta de infraestruturas no trabalho ou escola como, por exemplo, parques próprios ou duches e vestiários
- ☐ Other: _____

Skip to question 21.

Hábitos de Mobilidade IV

19. **Porque se desloca a pé ou de bicicleta?** *
Check all that apply.

- [ ] Rede de transporte deficitária (falta de transportes na sua região)
- [ ] Razões económicas
- [ ] Razões ambientais
- [ ] Razões de saúde
- [ ] Rapidez
- [ ] Pequenas distâncias (1 a 2 km)
- [ ] Como complemento aos transportes públicos
- [ ] Other: _____

20. **Com que frequência se desloca a pé ou de bicicleta?** *
Mark only one oval.

- ◯ Raramente (menos de uma vez por mês)
- ◯ Ocasionalmente (pelo menos uma vez por mês)
- ◯ 1 a 3 vezes por semana
- ◯ Diariamente

Intermodalidade

21. **Quantos meios de transporte (bicicleta/mota/carro/autocarro/metro /eléctrico/comboio/táxi) usa para se deslocar diariamente:** *
Mark only one oval.

- ◯ 1 *Skip to question 25.*
- ◯ 2
- ◯ 3 ou mais
- ◯ Não uso diariamente *Skip to question 25.*

Intermodalidade - continuação

22. **Quanto tempo passa, em minutos, à espera do(s) próximo(s) transporte(s)?** *
Mark only one oval.

- ◯ Menos de 5
- ◯ 5 a 10
- ◯ 10 a 15
- ◯ 15 a 20
- ◯ 20 a 30
- ◯ Mais de 30

23. **Qual a distância, em metros, entre a correspondência? ***
Se na mesma paragem/estação selecione "0m"
Mark only one oval.

- ◯ 0 m
- ◯ 0 a 10 m
- ◯ 10 a 25 m
- ◯ 25 a 50 m
- ◯ 50 a 100 m
- ◯ Mais de 100 m

24. **Para um novo utilizador acha que é fácil encontrar a paragem/estação de correspondência? ***
Mark only one oval.

- ◯ Sim
- ◯ Não

Intermodalidade II

25. **Classifique: ***
Mark only one oval per row.

	Não importante	Pouco importante	Importante	Muito importante	Não sei
Tempo de espera entre o transbordo (mudança de modo de transporte)	◯	◯	◯	◯	◯
Informação disponível (tempo real, horários e localização no sitio de internet do operador,aplicação móvel, paragens ou veículos)	◯	◯	◯	◯	◯
Distância entre as estações ou paragens	◯	◯	◯	◯	◯
Coordenação com outros transportes	◯	◯	◯	◯	◯
Preço intermodal (tarifas para utilização de diferentes meios de transporte)	◯	◯	◯	◯	◯
Infraestruturas adequadas (por exemplo: estacionamento para carros/motas/bicicletas nasestações, espaços dedicados às bicicletas nos autocarros/eléctricos/metros/comboios, etc.)	◯	◯	◯	◯	◯

26. **O que achas dos locais de interface de transporte (estações ou paragens)? ***
Check all that apply.

- [ ] Falta de segurança
- [ ] Informação confusa
- [ ] Falta de bancos
- [ ] Temperatura inadequada (frio ou calor)
- [ ] Other: _____

Sistemas de Informação

27. **Como classifica a informação disponível pelos operadores de transportes público em Lisboa, em termos de: ***
Mark only one oval per row.

	Muito Boa	Boa	Fraca	Má	Não sei
Informação na internet: horários	◯	◯	◯	◯	◯
Informação na internet: percursos	◯	◯	◯	◯	◯
Informação nas paragens: horários	◯	◯	◯	◯	◯
Informação nas paragens: percursos	◯	◯	◯	◯	◯
Informação nas paragens: tempo-real	◯	◯	◯	◯	◯
Informação nos veículos: próximas paragens	◯	◯	◯	◯	◯
Informação nos veículos sobre as correspondências com outros modos de transporte	◯	◯	◯	◯	◯

28. **O que pensa da informação na:**
Mark only one oval per row.

	Muito Boa	Boa	Fraca	Má	Não conheço
Aplicação móvel "Lisboa MOVE-ME"	◯	◯	◯	◯	◯
Página de internet "Transportis.pt"	◯	◯	◯	◯	◯

29. **Classifique de 1 a 8, quanto ao que pensa da existência de informação ao passageiro:** *

1 - Menos importante; 8 - Mais importante (apenas uma resposta por coluna - NÃO REPITA OS NÚMEROS)
Mark only one oval per row.

	1	2	3	4	5	6	7	8
Nas paragens	◯	◯	◯	◯	◯	◯	◯	◯
Nas paragens, em tempo-real	◯	◯	◯	◯	◯	◯	◯	◯
Nos veículos	◯	◯	◯	◯	◯	◯	◯	◯
Nos veículos, em tempo-real	◯	◯	◯	◯	◯	◯	◯	◯
No site dos operadores	◯	◯	◯	◯	◯	◯	◯	◯
No site dos operadores, em tempo-real	◯	◯	◯	◯	◯	◯	◯	◯
Em aplicações móveis	◯	◯	◯	◯	◯	◯	◯	◯
Em aplicações móveis, em tempo-real	◯	◯	◯	◯	◯	◯	◯	◯

30. **Sugestões de melhoria ao nível da informação disponível aos passageiros. Sobre o quê gostaria de ser informado?**

_____

_____

_____

_____

_____

Sistema de Bilhetes e Tarifas

31. **O que pensa da tarifa praticada atualmente nos transportes públicos?** *

Mark only one oval.

- ◯ Adequada
- ◯ Acessível
- ◯ Cara
- ◯ Não sei

32. **O que pensaria de pagar mais pelo serviço para que tivesse melhores condições?** *

Mark only one oval.

- ◯ Estaria de acordo
- ◯ Dependia das melhorias
- ◯ Totalmente em desacordo

33. **Como paga normalmente a sua viagem no transporte público?** *
Mark only one oval.

- ◯ Passe mensal no cartão Lisboa Viva
- ◯ Viva viagem/Zapping carregado com dinheiro
- ◯ Viva viagem/Zapping com viagens individuais
- ◯ Compro bilhete de bordo ao condutor
- ◯ Other: _____

34. **Seleccione os operadores de transporte público que utiliza diariamente?** *
Check all that apply.

- ☐ Carris
- ☐ TST
- ☐ Rodoviária de Lisboa
- ☐ Vimeca e/ou Lisboa Transportes
- ☐ Metro
- ☐ MTS
- ☐ CP
- ☐ Fertagus
- ☐ Transtejo
- ☐ Soflusa
- ☐ Sulfertagus
- ☐ Other: _____

35. **Tem alguma sugestão de melhoria ao nível dos bilhetes ou tarifas de transporte?**

_____

_____

_____

_____

_____

A sua opinião

36. **O que acharia de:** *

Mark only one oval per row.

	Irrelevante	Pouco Relevante	Relevante	Muito Relevante	Não sei
Pagar somente o que utiliza (pagar por km)	◯	◯	◯	◯	◯
Viajar com mais pessoas num mesmo bilhete	◯	◯	◯	◯	◯
Informação em tempo real nos veículos das correspondências e seus horários	◯	◯	◯	◯	◯
Tempo real em todas as estações e paragens	◯	◯	◯	◯	◯
Informação sobre a conexão e sobre se é o ultimo veiculo	◯	◯	◯	◯	◯
Informação do percurso mais rápido incluindo diferentes modos de transporte	◯	◯	◯	◯	◯
Localização em tempo real do veiculo	◯	◯	◯	◯	◯
Informação em tempo real sobre a lotação do transporte (veículo completo ou não)	◯	◯	◯	◯	◯
Sinalização na estação do local de entrada para as bicicletas nos comboios e não apenas no próprio comboio	◯	◯	◯	◯	◯
Informação sonora da carruagem (comboio/metro/eléctrico) destinada às bicicletas	◯	◯	◯	◯	◯
Melhores acessos para as bicicletas nas estações	◯	◯	◯	◯	◯
Informação em tempo real do espaço para a bicicleta nos veículos de transporte público	◯	◯	◯	◯	◯
Presença de bicicletas nos veículos permitida em todas as horas	◯	◯	◯	◯	◯
Desconto estudante	◯	◯	◯	◯	◯
Desconto jovem menor de 26 anos	◯	◯	◯	◯	◯
Descontos especiais ao fim de semana, principalmente em longas distâncias	◯	◯	◯	◯	◯
Mais parques de estacionamento carros e bicicletas nas estações nos arredores/acessos à cidade	◯	◯	◯	◯	◯
Mais vias reservadas às bicicletas	◯	◯	◯	◯	◯

37. **De maneira geral, qual é a sua satisfação do serviço de transportes da cidade?** *
Mark only one oval.

- ◯ Muito satisfeito(a)
- ◯ Satisfeito(a)
- ◯ Insatisfeito(a)
- ◯ Muito insatisfeito(a)

38. **Tem algumas sugestões de melhoria para a mobilidade urbana na cidade de Lisboa? O que para si seria mais relevante para tornar os transportes públicos mais atrativos?**

_____

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Annex VI – Complete Brussels Mobility Survey Results

Personal Data

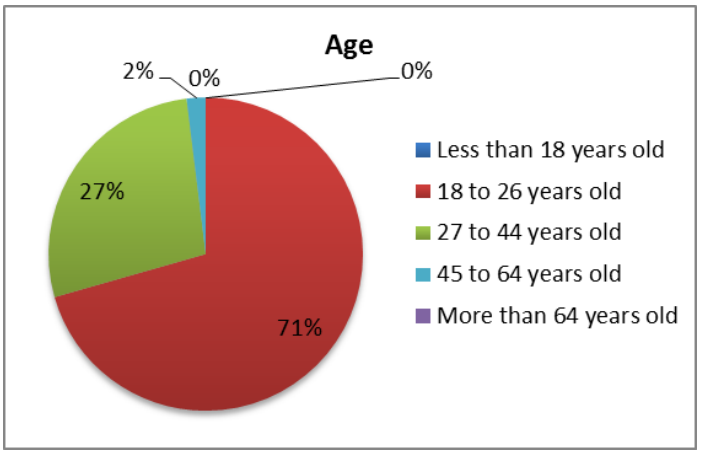

Figure A6.1 - Age of the respondents.

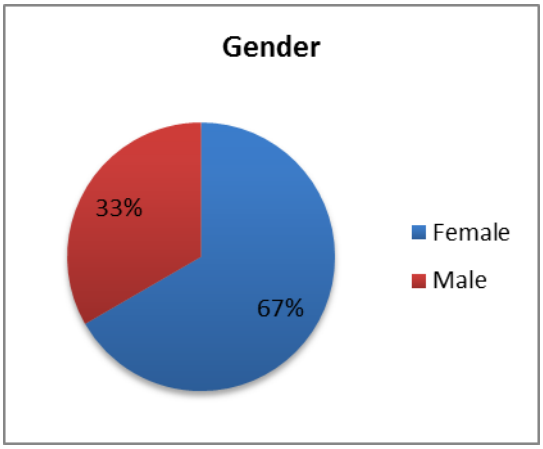

Figure A6.2 - Gender of the respondents.

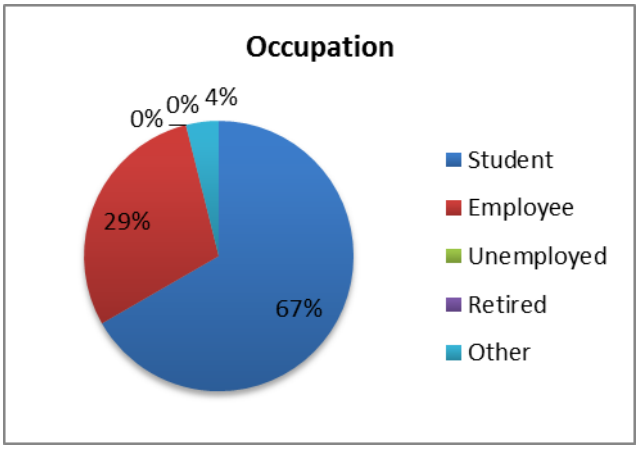

Figure A6.3 - Occupation of the respondents.

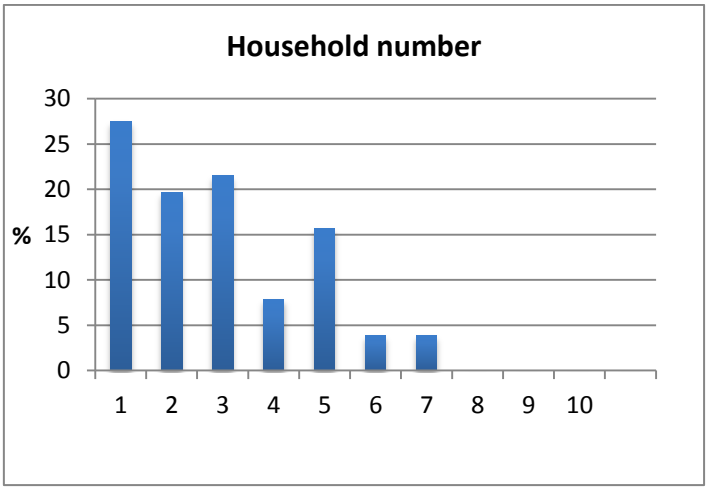

Figure A6.4 - Household number of the respondents.

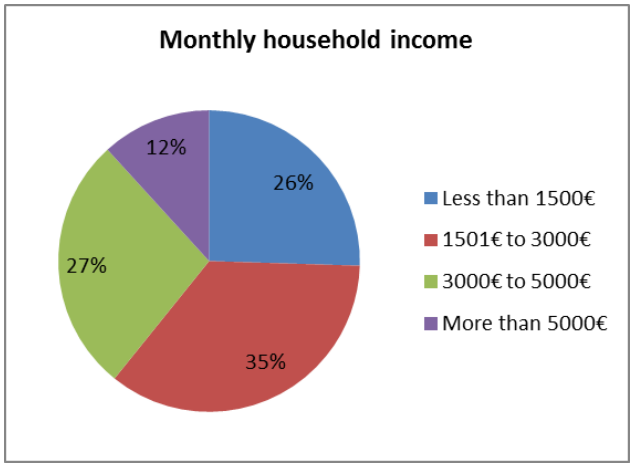

Figure A6.5 - Monthly household income of the respondents.

Mobility Habits

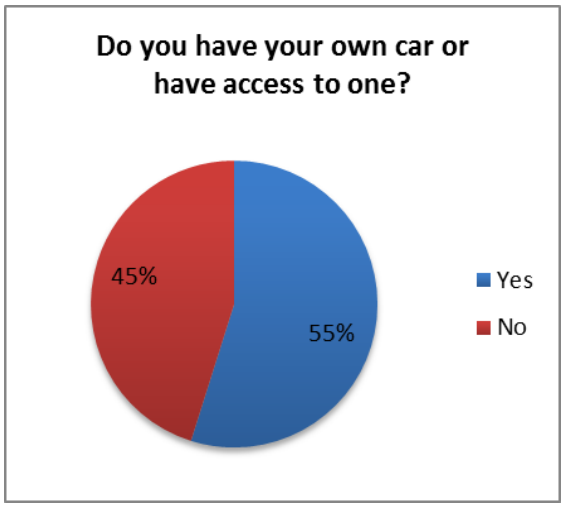

Figure A6.6 - Car owner or access to a car.

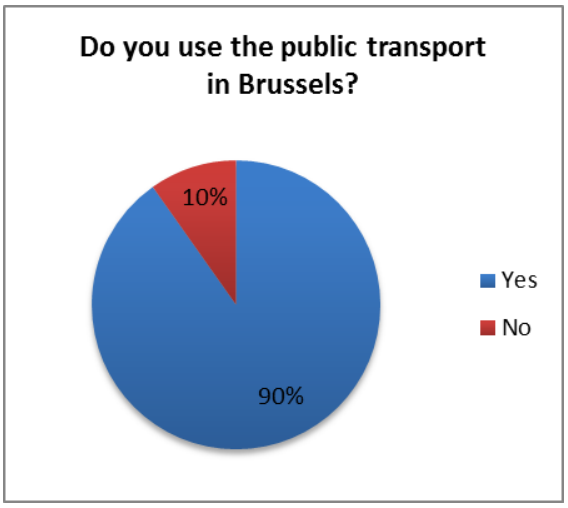

Figure A6.7 - Use of public transport in Brussels.

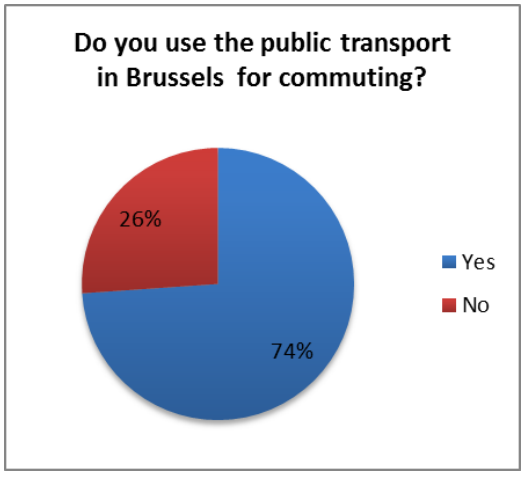

Figure A6.8 - Use of public transport to commute in Brussels.

Table A6. 1- Reasons to not use public transport in Brussels.

Why do you not use public transport in Brussels?	%
Deficient transport network (lack of transport in your area)	9,1
Long waiting time	0,0
High travel time	18,2
High number of correspondences	9,1
High waiting time between correspondence	9,1
Lack of passenger information (e.g. timetables and fares)	0,0
Weather conditions such as rain, cold or heat	0,0
Insecurity	9,1
Comfort	18,2
Other	27,3

Table A6. 2 - How often the respondents use public transport in Brussels.

How often do you use public transport in Brussels?	%
Rarely (less than once per month)	2,2
Occasionally (at least once per month)	13,0
1 to 3 times a week	28,3
Daily	56,5

Table A6. 3 - Reasons to use public transport to commute.

Why do you use public transportation to commute?	%
Economic reasons	19,0
Environmental reasons	24,1
Quickness	17,2
More practical (e.g. lack of parking)	25,9
Has no driving license	10,3
Other	3,4

Table A6. 4 – Distance from respondents home to work or school.

What is the distance from your home to work or school?	%
Less than 3 km	21,2
Between 3 to 6 km	15,2
Between 6 to 10 km	39,4
Between 10 to 20 km	12,1
Between 20 to 40 km	9,1
More than 40 km	3,0

Soft Mobility

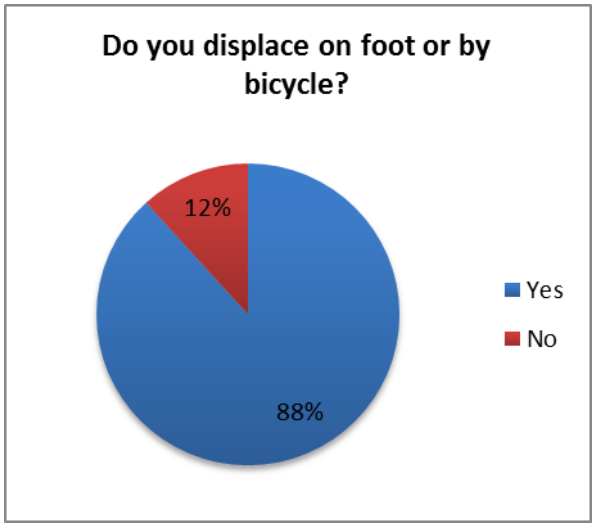

Figure A6.9 - Displace on foot or bicycle.

Table A6. 5 – Reasons to displace on foot or by bicycle.

Why do you displace on foot or by bicycle?	%
Deficient transport network (lack of transport in your area)	5,8
Economic reasons	2,3
Environmental reasons	5,8
Health reasons	15,1
Quickness	15,1
Short distances (1 to 2 km)	36,0
As a complement to public transportation	19,8
Other	0

Table A6. 6 - How often the respondents displace on foot or by bicycle.

How often do you displace on foot or by bicycle?	%
Rarely (less than once per month)	2,4
Occasionally (at least once per month)	7,1
1 to 3 times a week	45,2
Daily	45,2

Table A6. 7 - Reasons to not displace on foot or by bicycle.

Why do you not displace on foot or by bicycle?	%
Weather conditions such as rain, cold or heat	10,0
Street slope (inclination of the streets)	20,0
Lack of tracks reserved to bicycles	20,0
Insecurity on the road	30,0
Lack of infrastructure at work or school, for example, proper parks or showers and locker	0,0
Other	20,0

Intermodality

Table A6. 8 - Number of transport modes that respondents use daily.

How many transport modes do you use daily?	%
1	43,1
2	41,2
3 or more	11,8
I do not use daily	3,9

Table A6. 9 - Waiting time until the next transport(s).

How much time do you spend waiting for the next transport(s)?	%
Less than 5 minutes	25,9
5 to 10 minutes	44,4
10 to 15 minutes	18,5
15 to 20 minutes	7,4
20 to 30 minutes	0,0
More than 30 minutes	3,7

Table A6. 10 - Distance between correspondences.

What is the distance between correspondences?	%
At the same stop/station	36,0
0 to 20 m	32,0
20 to 50 m	20,0
50 to 100 m	4,0
More than 100 m	8,0

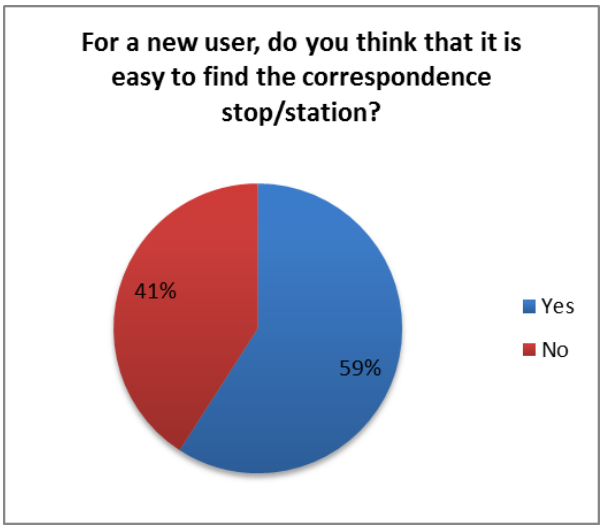

Figure A6.10 - Ease of correspondence for new users.

Table A6. 11 –Classification of the most important (1- Less important; 6- More important).

Classify from 1 to 6:	1	2	3	4	5	6
	%	%	%	%	%	%
Waiting time between the correspondence (change of mode of transport)	5,9	3,9	3,9	19,6	23,5	43,1
Available information (real-time, timetables and location in the operator website, mobile app, stops or vehicles)	0,0	9,8	17,6	21,6	31,4	19,6
Distance between stations or stops	21,6	23,5	27,5	13,7	13,7	0,0
Coordination with other transport	5,9	19,6	27,5	23,5	11,8	11,8
Intermodal price (tariffs for use of different means of transport)	17,6	27,5	11,8	15,7	13,7	13,7
Adequate infrastructure (e.g. parking at station for cars / motorcycles / bicycles s, spaces dedicated to bicycles on buses / trams / meters / convoy, etc.)	49,0	15,7	11,8	5,9	5,9	11,8

Table A6. 12 - Respondents opinion about transport interchanges.

What do you think of the transport interchanges?	%
Lack of security	21,2
Confusing information	16,7
Lack of seats	22,7
Inadequate temperature (cold or hot)	19,7
Other	19,7

Information Systems

Table A6. 13 - Classification of the information available by public transport operators in Lisbon.

How do you classify the information made available by public transport operators in Lisbon, in terms of:	Very Good	Good	Weak	Bad	Do not know
	%	%	%	%	%
Information on the Internet: timetables	27,5	51,0	11,8	5,9	3,9
Information on the Internet: itineraries	21,6	49,0	11,8	9,8	7,8
Information on mobile app	23,5	47,1	9,8	3,9	15,7
Time predicted reliability of the vehicle passing through the stop (timetables)	19,6	52,9	27,5	0,0	0,0
Reliability time of arrival at the destination	15,7	49,0	27,5	3,9	3,9
Information at stops in real-time	25,5	52,9	19,6	0,0	2,0
Information on vehicles in real-time	23,5	47,1	17,6	3,9	7,8
Audio information on vehicles	13,7	47,1	29,4	9,8	0,0
Information on vehicles about correspondence with other modes of transport	9,8	41,2	37,3	7,8	3,9
Panels with the location of the correspondence stop (when the correspondence is not in the same stop)	2,0	37,3	31,4	21,6	7,8
Information in case of service disturbance	2,0	29,4	41,2	21,6	5,9

Table A6. 14 - –Classification of the most important passenger information (1-Less important; 8-More important).

Rate from 1 to 8, the current passenger information:	1	2	3	4	5	6	7	8
	%	%	%	%	%	%	%	%
At stops	5,9	9,8	19,6	17,6	11,8	7,8	11,8	15,7
At stops, in real-time	0,0	7,8	3,9	7,8	2,0	17,6	23,5	37,3
On vehicles	17,6	15,7	19,6	7,8	17,6	9,8	9,8	2,0
On vehicles, in real-time	5,9	5,9	7,8	19,6	17,6	25,5	9,8	7,8
On website	23,5	19,6	11,8	19,6	11,8	0,0	5,9	7,8
On website, in real-time	13,7	9,8	15,7	5,9	17,6	25,5	9,8	2,0
On mobile apps	19,6	17,6	19,6	3,9	15,7	3,9	17,6	2,0
On mobile apps, in real-time	13,7	13,7	2,0	17,6	5,9	9,8	11,8	25,5

Ticketing Systems

Table A6. 15 - Opinion of the respondents about the current fares of the public transport.

What do you think of the current fares of the public transport?	%
Adequate	19,6
Affordable	39,2
Expensive	41,2
Do not know	0

Table A6. 16 – Method of paying the public transport.

How do you usually pay your trip on public transport?	%
Season ticket/Pass	68,6
Tickets on MOBIB or MOBIB basic card	17,6
One journey or single or multiple ticket	5,9
Onboard ticket, bought to the driver	2,0
I do not use public transports	5,9

Table A6. 17 – Public transport operators used daily by the respondents.

What public transport operators do you use daily?	%
STIB	55,8
TEC	9,3
De Lijn	4,7
SNCB	27,9
I do not use public transports	2,3
Other	0,0

Opinion

Table A6. 18 – Opinion of the respondents about some proposed measures.

What would you think of:	Do not know	Irrelevant	Little relevance	Relevant	Very relevant
	%	%	%	%	%
Pay only for what you use (pay per km)	3,9	17,6	41,2	19,6	17,6
Travel with more people on the same ticket	7,8	11,8	19,6	41,2	19,6
Real-time information on vehicles of correspondences and their timetables	2,0	0,0	5,9	33,3	58,8
Signs at the stations identifying the entrance for bicycles on trains and not just on the train itself	11,8	0,0	23,5	43,1	21,6
Better access for bikes at stations	11,8	0,0	15,7	37,3	35,3
More space for bicycles at transports	9,8	2,0	19,6	33,3	35,3
A single subscription price for all public transport and bicycle system in the same area (does not matter the operator)	5,9	0,0	15,7	29,4	49,0
Real-time information on the capacity of transport (complete vehicle or not)	7,8	15,7	31,4	31,4	13,7
Real-time information about the space available for bicycles in public transport vehicles	13,7	5,9	29,4	33,3	17,6
Bicycle presence in vehicles allowed at all hours	15,7	3,9	35,3	21,6	23,5
Youth discount minor 26 years	2,0	0,0	7,8	27,5	62,7
Precise information about correspondences	2,0	2,0	7,8	31,4	56,9
Quickest route information including different modes of transport	2,0	2,0	3,9	29,4	62,7
Information about Villo! Stations on vehicles	7,8	5,9	11,8	45,1	29,4
More car and bicycles parks at stations in outskirts of the city	9,8	0,0	15,7	47,1	27,5
More ways reserved for bicycles	11,8	0,0	13,7	35,3	39,2

Table A6. 19 – Level of satisfaction of the city transports.

What is your level of satisfaction of the city transports?	%
Very satisfied	11,8
Satisfied	72,5
Unsatisfied	11,8
Very unsatisfied	3,9

Annex VII – Complete Lisbon Mobility Survey Results

Personal Data

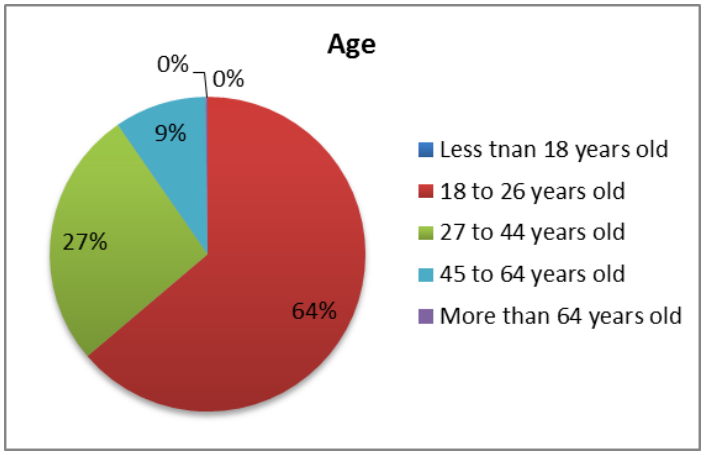

Figure A7.1 - Age of the respondents.

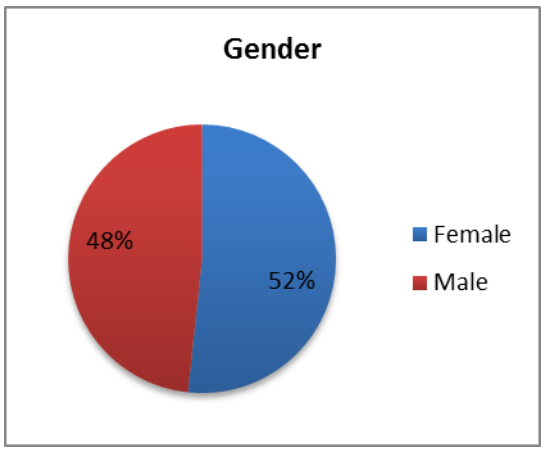

Figure A7.2 - Gender of the respondents.

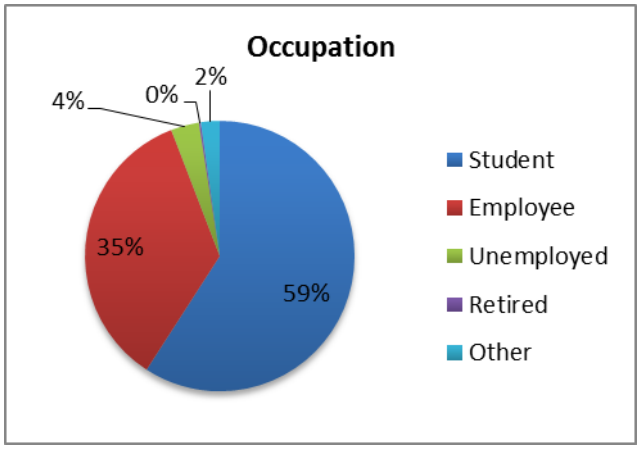

Figure A7.3 - Occupation of the respondents.

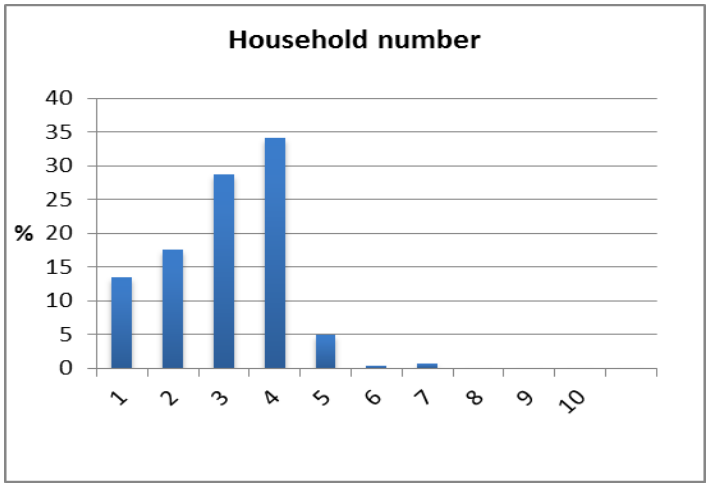

Figure A7.4 – Household number of the respondents.

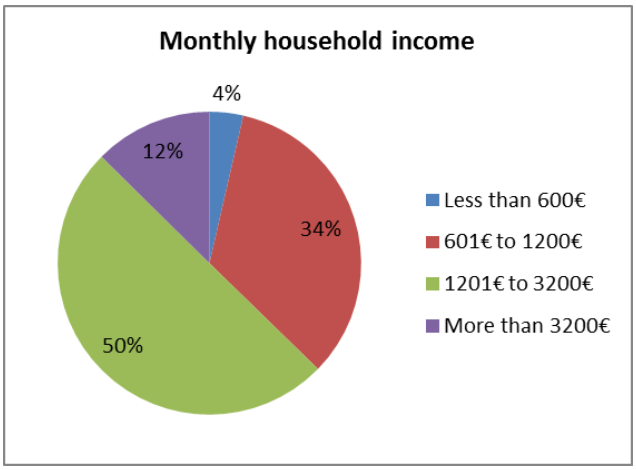

Figure A7.5 - Monthly household income of the respondents.

Mobility Habits

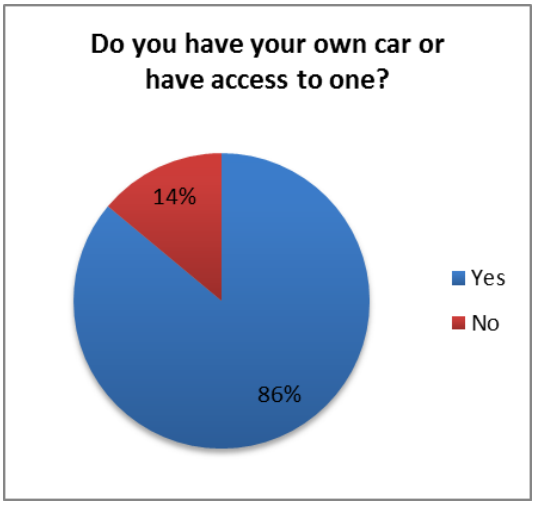

Figure A7.6 - Car owner or access to a car.

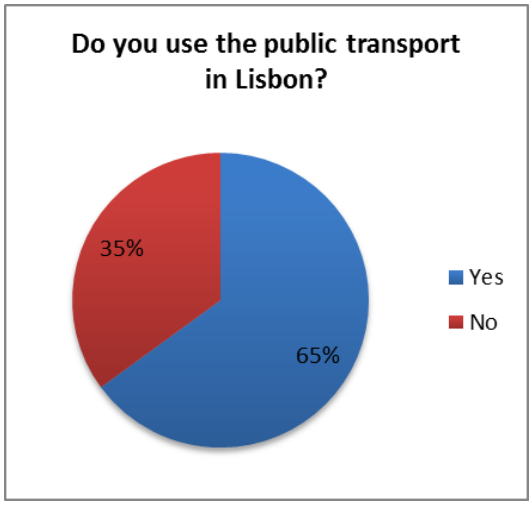

Figure A7.7 - Use of public transport in Lisbon.

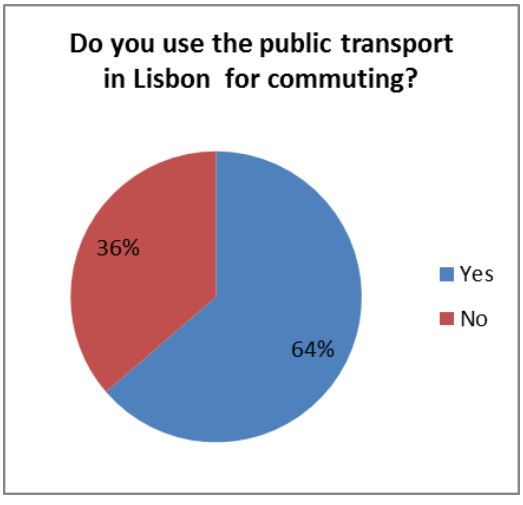

Figure A7.8 - Use of public transport to commute in Lisbon.

Table A7. 1 - Reasons to not use public transport in Lisbon.

Why do you not use public transport in Lisbon?	%
Deficient transport network (lack of transport in your area)	11,8
Long waiting time	12,7
High travel time	20,1
High number of correspondences	11,8
High waiting time between correspondence	6,5
Lack of passenger information (e.g. timetables and fares)	1,2
Weather conditions such as rain, cold or heat	2,8
Insecurity	6,2
Comfort	12,1
Other	14,9

Table A7. 2 - How often the respondents use public transport in Lisbon.

How often do you use public transport in Lisbon?	%
Rarely (less than once per month)	13,1
Occasionally (at least once per month)	25,6
1 to 3 times a week	14,9
Daily	46,4

Table A7. 3 - Reasons to use public transport to commute.

Why do you use public transport to commute?	%
Economic reasons	42,0
Environmental reasons	15,5
Quickness	9,4
More practical (e.g. lack of parking)	24,6
Has no driving license	4,7
Other	3,9

Table A7. 4 - Distance from respondents home to work or school.

What is the distance from your home to work or school?	%
Less than 3 km	4,0
Between 3 to 6 km	6,9
Between 6 to 10 km	14,3
Between 10 to 20 km	31,4
Between 20 to 40 km	34,3
More than 40 km	9,1

Soft Mobility

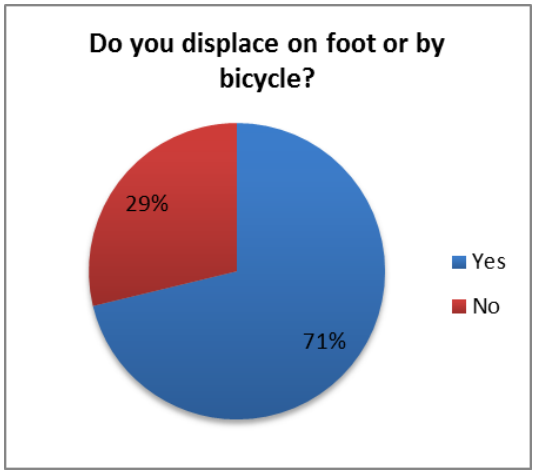

Figure A7.9 - Displace on foot or bicycle.

Table A7. 5 - Reasons to displace on foot or by bicycle.

Why do you displace on foot or by bicycle?	%
Deficient transport network (lack of transport in your area)	3,3
Economic reasons	13,1
Environmental reasons	8,5
Health reasons	8,8
Quickness	8,5
Short distances (1 to 2 km)	36,4
As a complement to public transportation	18,1
Other	3,3

Table A7. 6 - How often the respondents displace on foot or by bicycle.

How often do you displace on foot or by bicycle?	%
Rarely (less than once per month)	10,7
Occasionally (at least once per month)	30,6
1 to 3 times a week	23,0
Daily	35,6

Table A7. 7 - Reasons to not displace on foot or by bicycle.

Why do you not displace on foot or by bicycle?	%
Weather conditions such as rain, cold or heat	16,6
Street slope (inclination of the streets)	18,0
Lack of tracks reserved to bicycles	18,0
Insecurity on the road	16,6
Lack of infrastructure at work or school, for example, proper parks or showers and locker	11,8
Other	19,0

Intermodality

Table A7. 8 - Number of transport modes that respondents use daily.

How many transport modes do you use daily?	%
1	47,4
2	22,9
3 or more	19,1
I do not use daily	10,6

Table A7. 9 - Waiting time until the next transport(s).

How much time do you spend waiting for the next transport(s)?	%
Less than 5 minutes	11,8
5 to 10 minutes	42,8
10 to 15 minutes	30,5
15 to 20 minutes	7,5
20 to 30 minutes	4,8
More than 30 minutes	2,7

Table A7. 10 - Distance between correspondences.

What is the distance between correspondences?	%
0 m	28,3
0 to 10 m	15,0
10 to 25 m	15,5
25 to 50 m	13,9
50 to 100 m	12,3
More than 100 m	15,0

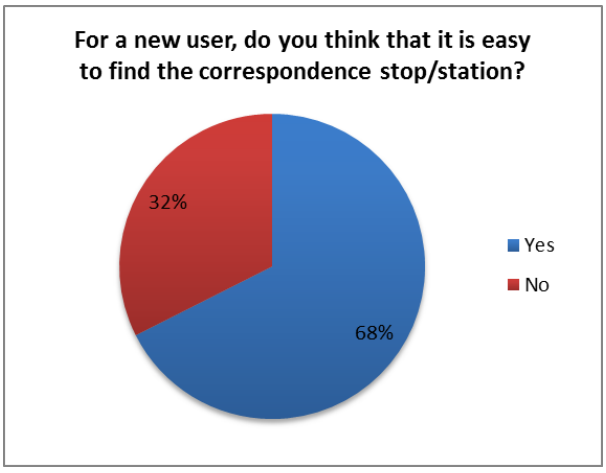

Figure A7.10 - Ease of correspondence for new users.

Table A7. 11 - Classification of the most important intermodality subject.

Classify:	Not important	Little important	Important	Very important	Do not know
	%	%	%	%	%
Waiting time between the correspondence (change of mode of transport)	1,1	1,8	31,0	63,6	2,5
Available information (real-time, timetables and location in the operator website, mobile app, stops or vehicles)	0,2	2,7	24,9	69,9	2,2
Distance between stations or stops	2,7	18,7	44,7	31,5	2,5
Coordination with other transport	0,4	1,1	20,2	76,2	2,0
Intermodal price (tariffs for use of different means of transport)	0,4	2,5	20,0	72,8	4,3
Adequate infrastructure (e.g. parking at station for cars / motorcycles / bicycles s, spaces dedicated to bicycles on buses / trams / meters / convoy, etc.)	1,6	8,1	36,4	50,8	3,1

Table A7. 12 - Respondents opinion about transport interchanges.

What do you think of the transport interchanges?	%
Lack of security	28,2
Confusing information	21,0
Lack of seats	24,7
Inadequate temperature (cold or hot)	18,9
Other	7,3

Information Systems

Table A7. 13 - Classification of the information made available by public transport operators in Lisbon.

How do you classify the information made available by public transport operators in Lisbon, in terms of:	Very Good	Good	Weak	Bad	Do not know
	%	%	%	%	%
Information on the Internet: timetables	14,8	59,1	14,8	2,7	8,5
Information on the Internet: itineraries	14,4	54,2	19,1	3,8	8,5
Information at stops: timetables	3,1	42,5	35,3	10,6	8,5
Information at stops: itineraries	4,3	41,6	31,7	13,9	8,5
Information at stops: real-time	2,5	31,2	34,8	21,3	10,1
Information on vehicles: next stops	5,2	42,5	30,8	12,6	9,0
Information on vehicles about correspondence with other modes of transport	2,2	28,8	36,2	23,6	9,2

Table A7. 14 - Respondents opinion about information on mobile app and website.

What do you think of the information on:	Very Good	Good	Weak	Bad	Do not know
	%	%	%	%	%
Mobile app "Lisboa MOVEME"	1,6	9,0	3,2	1,1	85,1
Website "Transporlis.pt"	2,5	14,7	5,4	1,4	76,0

Table A7. 15 - Classification of the most important passenger information (1-Less important; 8-More important).

Rate from 1 to 8, the current passenger information:	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	6 (%)	7 (%)	8 (%)
At stops	4,3	2,2	7,4	9,0	9,2	12,1	25,4	30,3
At stops, in real-time	2,7	2,2	3,4	6,3	5,8	13,7	20,9	44,9
On vehicles	9,0	7,9	8,1	13,3	14,4	18,9	17,1	11,5
On vehicles, in real-time	5,4	7,0	7,0	10,3	13,5	18,0	20,7	18,2
On operators website	11,2	7,2	10,8	12,6	11,9	10,1	16,9	19,3
On operators website, in real-time	7,2	11,7	11,7	13,0	12,4	15,3	12,4	16,4
On mobile apps	11,5	11,7	11,7	10,6	9,9	10,6	20,9	13,3
On mobile apps, in real-time	9,4	8,3	5,8	12,1	10,3	16,6	16,9	20,4

Ticketing Systems

Table A7. 16 - Opinion of the respondents about the current fares of the public transport.

What do you think of the current fares of the public transport?	%
Adequate	4,7
Affordable	13,0
Expensive	78,7
Do not know	3,6

Table A7. 17 – Respondents opinion about an increase of tariffs.

What would you think of paying more for the service in order to have better conditions?	%
I would agree	5,8
Depended on improvements	69,0
Totally disagree	25,2

Table A7. 18 - Method of paying the public transport.

How do you usually pay your trip on public transport?	%
Season ticket/Pass	39,8
Viva Viagem/Zapping charge with money	22,7
Viva Viagem/Zapping with single tickets	23,6
Onboard ticket, bought to the driver	9,9
Other	4,0

Table A7. 19 - Public transport operators used daily by the respondents.

What public transport operators do you use daily?	%
Carris	11,5
TST	9,0
Rodoviária de Lisboa	1,8
Vimeca e/ou Lisboa Transportes	2,1
Metro (ML)	20,6
MTS	14,1
CP	9,7
Fertagus	13,3
Transtejo	3,9
Soflusa	1,0
Sulfertagus	1,6
Other	11,4

Opinion

Table A7. 20 - Opinion of the respondents about some proposed measures.

What would you think of:	Do not know	Irrelevant	Little relevance	Relevant	Very relevant
	%	%	%	%	%
Pay only for what you use (pay per km)	6,5	13,0	20,0	32,7	27,8
Travel with more people on the same ticket	5,2	15,2	21,7	33,6	24,2
Real-time information on vehicles of correspondences and their timetables	1,3	2,0	4,3	36,3	56,1
Real-time at all stations and stops	1,8	1,6	3,6	28,0	65,0
Information about the connection and whether it is the last vehicle	2,5	1,3	6,1	39,0	51,1
Quickest route information including different modes of transport	2,9	1,6	6,7	33,9	54,9
Real-time location of the vehicle	1,8	4,3	15,9	39,2	38,8
Real-time information on the capacity of transport (complete vehicle or not)	1,3	6,5	21,3	41,7	29,1

What would you think of:	Do not know	Irrelevant	Little relevance	Relevant	Very relevant
	%	%	%	%	%
Signs at the stations identifying the entrance for bicycles on trains and not just on the train itself	6,3	5,2	19,7	42,6	26,2
Audio information of the carriage (train / metro / tram) designed for bicycles	7,8	11,0	28,0	31,8	21,3
Better access for bikes at stations	6,7	6,3	17,5	40,1	29,4
Real-time information about the space available for in public transport vehicles	7,2	9,0	25,8	34,5	23,5
Bicycle presence in vehicles allowed at all hours	7,2	6,1	19,1	32,7	35,0
Student discount up to 26 years	5,4	2,0	1,8	17,3	73,5
Youth discount minor 26 years	5,6	3,1	5,2	17,5	68,6
Special discounts at the weekend, particularly over long distances	4,5	2,2	5,8	22,0	65,5
More car and bicycles parks at stations in outskirts of the city	5,6	3,1	8,3	29,1	53,8
More ways reserved for bicycles	6,3	5,4	12,3	30,7	45,3

Table A7. 21 - Level of satisfaction of the city transports.

What is your level of satisfaction of the city transports?	%
Very satisfied	2,5
Satisfied	60,4
Unsatisfied	33,9
Very unsatisfied	3,1

Annex VIII – Registration of Travels in the Public Transport of Brussels

Table A8. 1- Registration of travels in the public transport of Brussels.

Dia	Transp.	No.		Partida	Chegada	Observações	
27-fev	B	80	1	*Science*	*Caréne*		
	B	80	1	*Caréne*	*Georges Henri*	Falta de informação ao passageiro na correspondência levou a que tenha ido até à proxima estação apanhar o electrico, apesar de a informação no Bus dizer que se podia mudar para o tram 7 na paragem georges Henri, contudo nao se vi a paragem do electrico nem qlq tipo de informação.	
	T	7		*Montgomert*	*Gossart*		
01-abr	T	7	1	*Gossart*	*Churchill*	App funcionou bem	
	T	3		*Churchill*	*Gare du Midi*		
	T	3	1	*Gare du Midi*	*Churchill*		
	T	7		*Churchill*	*Gossart*		
25-abr	B	38	1	*Montjoie*	*Vleurgat*	App :)	
	T	94		*Vleurgat*	*Louize*		
	N	10	1	*Petit Sablon*	*Cavell*		
30-abr	B	38	1	*Montjoie*	*Flagey*		
01-mai	B	38	1	*Flagey*	*Montjoie*	Info paragem e app :)	
	N	10	1	*Bourse*	*Cavell*		
02-mai	B	38	1	*Montjoie*	*Blyckaerts*	App :)	
	B	38	1	*Flagey*	*Montjoie*		
09-mai	B	38	1	*Montijoie*	*Bascule*	app info 38 montjoie nao funcionou bem, desisti e fui a pé de Bascule à Flagey - se a info correcta tinha optado por outra solução.	
	B	71	1	*Flagey*	*Porte de Namur*		
	N	10	1	*Bourse*	*Cavell*	info exterior bus errada "dizia fora de serviço" mas afinal estava em serviço. Passageiros estavam confusos, sobre se estava realmente a funcionar ou nao .info painel interior falhou entre washinton e edith cavell	
11-mai	B	38	1	*Montjoie*	*Bascule*	App :)	

Dia	Transp.	No.		Partida	Chegada	Observações	
12-mai	B	38	1	*Montjoie*	*Luxembourg*	App :)	
	B	38		*Luxembourg*	*Montjoie*		
	B	38	1	*Flagey*	*Montjoie*		
13-mai	B	38	1	*Montjoie*	*Trône*		
	T	93		*Botanique*	*Legrand*		
	T	7	1	*Legrand*	*Bascule*	Paragem Bascule - app dizia 6 minutos quando passou o bus	
	B	38		*Bascule*	*Montjoie*		
14-mai	T	7	1	*Gossart*	*Heysel*	App :)	
	T	19	1	*Centenaire*	*Du Wand*		
	T	3		*Du Wand*	*Bourse*		
	B	71	1	*Gare Centrale*	*Flagey*		
	B	38		*Flagey*	*Montjoie*		
15-mai	T	7		*Gossart*	*Churchill*		
	T	3	1	*Churchill*	*Gare du Midi*	Info tempo paragem bem e app tb :	
	Train	-		*Gare du Midi*	*Anvers*		
	Train	-	1	*Anvers*	*Gare Centrale*	App :) e info na paragem tb	
	B	38		*Gare Centrale*	*Bascule*		
16-mai	B	38	1	*Montijoie*	*Gare Centrale*	Tempo na app com problemas (aviso de peturbações)	Eventos causa problemas com horarios da app e horarios reais
	N	10	1	*Gare Centrale*	*Cavell*	Exceptionlamente saiu da gare centrale devido à festa Gay pride no centro que encerrou a rua.	
17-mai	B	38	1	*Montjoie*	*Luxembourg*	App :)	
19-mai	B	38	1	*Montjoie*	*Flagey*	:) - app de acordo	
	B	38	1	*Flagey*	*Montjoie*	App de acordo com a chegada do bus :)	
20-mai	T	94	1	*ULB*	*Legrand*	Sem info correspondência no ecran no veículo	
	T	7	1	*Gossart*	*Buyl*	Sem correspondência	
21-mai	B	38	1	*Montjoie*	*Bascule*	:) App a corresponder	
	B	38	1	*Bascule*	*Montjoie*	autocarro antigo, sem o novo sistema de informação contudo, com nome das paragens e info sonora	

Dia	Transp.	No.		Partida	Chegada	Observações	
22-mai	T	93	1	*Legrand*	*Louise*	Antigo só com informação sonora e só com correspondências de metro	
	B	38	1	*De Brouckere*	*Montjoie*	App nao informava que afinal o Bus ia para numa estação antes… e o tempo marcado na paragem também nao correspondia ao real tempo de espera	
23-mai	B	38	1	*Montjoie*	*Royale*	App dizia 20 minutos e passado 5 minutos já dizia 3 minutos	
	T	93	1	*Botanique*	*Legrand*	Sem correspondência - informação sonora da correspondencia do metro	
	B	38	1	*Montjoie*	*Royale*	App :)	
	N	10	1	*Bourse*	*Cavell*	Partiu 5 minutos mais cedo que o que dizia na informação na paragem	
24-mai	B	38	1	*Montjoie*	*Gare Central*	App 5 minutos avançada mas dizia "tempo teorico" - bus passou 5 minutos mais tarde	
	B	38	1	*Gare Central*	*Montjoie*	:)	
25-mai	T	3	1	*Churchill*	*Gare du Midi*	Nao tem info correspondencia, apenas info sonora, apesar de ter o "espaço" para tal, assim como existe nos BUS	Correspondencia um pouco confusa, nao se percebe bem onde se tem que ir para mudar de modo de transporte
	M	6		*Gare du Midi*	*Simonis*	Metro velho mas com informaçao sonora e do nome da paragem e destino. Espaço reservado para bicicletas, contudo indicação exterior de que é a carruagem das bicicletas é mt pouco visivel/preceptivel.	
	T	19	1	*collège sacré-coeur*	*Centenaire*		
	T	19		*Centenaire*	*Du Wand*		
	T	3	1	*Du Wand*	*De Brouckére*		
	M	1?		*De Brouckere*	*Mérode*		
	B	60	1	*Shuman*	*Cavell*		
30-mai	B	38	1	*Montjoie*	*Blyckaerts*		
	B	38		*Blyckaerts*	*Arenberg*		
	B	38	1	*Anspach-de Brouckere*	*Bascule*		
	B	38		*Bascule*	*Montjoie*		
	T	94	1	*Legrand*	*Louise*	:) app, info local e info interior bem	
	N	10	1	*Bourse*	*Cavell*	partida a horas, sem falhas na info interior	
01-jun	T	7	1	*Longchamps*	*Churchill*	App e info paragem real :)	

Dia	Transp.	No.		Partida	Chegada	Observações	
	T	3		*Churchill*	*Gare du Midi*		
	M	6		*Gare du Midi*	*Simonis*		
	M	2	1	*Simonis*	*Gare du Midi*	Queria trocar de Simonis para Elisabeth, mas ai apanhar o metro em direcção a Simonis, mas apenas para ir até Rogier. Contudo, nao consegui encontrar a ligação de Simonis com Elisabeth apesar de na carta com a rede de transporte	
	T	3		*Gare du Midi*	*De Bruckére*		
	B	38	1	*Gare Centrale*	*Trone*	App :)	
	B	38		*Luxembourg*	*Montjoie*		

Annex IX - Evaluation of Lisbon Intermodality

Table A9. 1 - Global evaluation of Lisbon intermodality.

		Interaction with other transports				
1st Transport Mode	Conditions of stations or stops	Correspondence	Information		Ticketing	
			Correspondence on board	Correspondence out board	Season Ticket	Single/Day Ticket
Metro - ML	☺	Bus - Carris	☹	😐	☺	☺
		Other bus operators	☹☹	☹	☹	☹
		Tram - Carris	☹☹	😐	☺	☺
		Train - CP	☺	☺	☺	☹
		Train - Fertagus			☹	☹
		Boat	☺	☺	N.A	N.A
Bus - Carris	😐	Other bus operators	☹	☹	☹	☹
		Metro - ML	☹	☹	☺	☺
		Tram - Carris	☹	☹	☺	☺
		Train - CP	☹	☹	☺	☹
		Train - Fertagus			☹	☹
		Boat	☹	☹	N.A	N.A
Tram -Carris	😐	Metro - ML	😐	☹	☺	☺
		Bus - Carris	☹	☹	☺	☺
		Other bus operators	N.A.	N.A.	☹	☹
		Train - CP	☹	☹	☺	☹
		Train - Fertagus	N.A.	N.A.	☹	☹
		Boat	😐	☹	N.A	N.A
Train - CP	😐	Metro - ML	😐	☺	☺	☹
		Bus - Carris	☹	😐	☺	☹
		Other bus operators	☹	☹	☹	☹
		Tram - Carris	☹	😐	☺	☹
		Train - Fertagus	☺	☺	☹	☹
		Boat	☺	☺	N.A	N.A

Legend:

☺ Good

😐 Not so Good

☹ Bad

☹☹ Not exist

N.A. Not applicable

Note:

Bus only urban

Ticketing - only Lisbon urban zone